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VOL. 2 DECEMBER, 1909 No. 6

ADDITIONAL NOTES UPON THE BREEDING OF THE COFFEE-BEAN WEEVIL

(*Araecerus fasciculatus* De Geer.)

By E. S. TUCKER, *Special Field Agent, Bureau of Entomology, Washington, D. C.*

Since my paper announcing the discovery of the attacks by the coffee-bean weevil in cornstalks was submitted for publication (27), observations upon the habits and life history of the insect under different conditions have been continued whenever possible, not only by myself, but by other agents associated with me in the cotton boll weevil investigation.

As a possible injurious insect of a very important staple crop, as noted in the case of corn, the coffee-bean weevil excites special attention. While no direct proof of adverse effect upon the development of the ears can yet be charged to this weevil, the nature of its work in attacking green stalks places it in an apprehensive attitude that will need close watching.

The observations concerning the breeding of the species in cornstalks during the winter and spring months have proved conclusively that it thrives without an interruption, although a large mortality of all stages was apparently caused by cold weather. On January 25 Mr. R. A. Cushman, while at Alexandria, La., found the weevils in all stages and their work generally occurring in old standing stalks in the field of their discovery. During an examination of the same field and others in the vicinity, made by myself on February 26 and 27, most stalks showed abundant evidences of work by the insect, although t this time the ground in all but two out of five fields on as many different plantations had been broken with middle-burster plows; and,

in consequence, the stalks on the plowed lands lay in pieces either on the surface or partly buried. The results of rigorous activity was displayed with the prevalence of live larvæ and pupæ in the damp buried parts of stalks, scarcely any dead stages occurring with them. With the dry uncovered or standing stalks, however, the exposure to freezing weather had evidently resulted in a large fatality, as most of the stages, including the few adults found, were dead Among the slight survival of stages above ground the pupæ exceeded in proportionate number, thus showing a superior hardiness of this stage. Some dead adults which were taken from standing stalks seemed to have perished suddenly when just ready for emergence, their bodies, in fact, filling the exit hole. The conclusion was reached that the conditions most favorable for survival depended upon the protection of earth, such as occurred with root stalks and buried pieces.

A diligent search was made to ascertain if the boll weevil might be found hibernating in the cavities formed by *Aræcerus fasciculatus,* or otherwise in split or hollow stems. Instead of finding any boll weevils, however, other insects were taken, among which were certain weevils that are apt to be mistaken by planters and field laborers for the cotton boll weevil. These in particular were the cow-pea pod-weevil (*Chalcodermus æneus* Boh.) and a common grain weevil (*Calandra oryzæ* Linn.). The failure to find a single boll weevil in the stalks at this time does not disprove its probable choice of this form of shelter, which may reasonably be expected to harbor this pest when in close proximity to infested cotton fields. In fact, cornstalks are known to afford very favorable hibernation quarters for the boll weevil, which, following after the ravages of *Aræcerus fasciculatus,* would find retreat doubly accessible.

To determine whether similar work by *Aræcerus fasciculatus* might be carried on in other localities of Louisiana an inspection of old cornfields was made at Mansura on March 1 and 2, which resulted in finding the same kind of invasion by the insects as at Alexandria. The opinion that such infestation was likely a matter of general occurrence was sustained by Mr. W. D. Hunter, who reported as an estimate that half of the stalks which he saw in the vicinity of Mansura, six days later, showed more or less injury, and with as many as five emergence holes appearing on a joint. Subsequently Mr. W. D. Pierce, while stopping at this place on a trip of inspection April 13, observed that the weevils were breeding abundantly in the same manner as noted before.

Since the facts had now determined an infestation of more than local extent, its significance applied prospectively to a large region in

which the climate and crop conditions offered corresponding inducements to the weevil, and naturally including southern Texas. To verify the part that Texas was expected to share, Mr. J. D. Mitchell inspected a number of old cornfields at Victoria, March 7 to 10, and in every one he readily found the weevil and evidence of its work. He estimated that not over 10 per cent. at most of the stalks were attacked. All of the information so far obtained, however, positively defined this newly-known habit of the weevil as an universal trait.

That this weevil is capable of breeding indefinitely in cornstalks was shown by its continuance of stages in the first collection of stalks obtained last year, on September 18, until the experimental test was purposely terminated on April 14 of the present year, covering a period of seven months; and, moreover, the insect has proven its ability to withstand the winter climate of Dallas, Tex., where the infested stalks were kept in a breeding box in an outdoor insectary. While the species has survived severer winter weather than where collected, no protection was afforded other than a dry screened cage under a roof.

In order to learn the particulars by personal observations concerning the reported attacks in green stalks, as mentioned in my previous paper (27), an inspection of the corn growing on the same plantation near Alexandria, La., where the weevils had been first detected in the rôle of a cornstalk pest, was made on August 3 of the present year. My search required only a few minutes at any place examined to obtain abundant evidence of the weevils' presence, though, contrary to expectations based on my first experience of last year, the lower joints instead of any above the ears were found attacked. Furthermore, the astonishing feature of their work was shown by severe attacks on the leaves. Upon stripping these leaves from the stalks the inner side of the base which encircles the stem above the node was found to be shredded with burrows, generally running in courses between the fibres, the work opening through the surface on account of the thin structure.

The finding of live larvæ occupying burrows in the damaged portions of the leaves clearly places the responsibility of the work upon this stage of the insect. Moreover, an adult was taken while resting on a blade. In the joints the larvæ were found embedded just under the surface at the node, the external effect being distinguishable by a blackened spot, indicating the point of entrance or oviposition. As the attacks occurred more commonly on leaves than stalks, the inference follows that the weevils first breed in the base of the leaves and later attack the joints, probably as each in turn begins to dry. On the whole, however, the stalks were in a green and sappy condition, some

still having fresh green leaves, although no leaf was found attacked except dried ones. Of course, from the nature of the attack, such leaves would dry prematurely, and to some extent injured stalks would be similarly affected. The infestation proved to be more prevalent in corn growing on land which had produced a like crop the year before and where old stalks remained than in fields on cotton land. Besides, the time of planting made some difference in the conditions of freshness in favor of the crop on the cotton land which was planted late. On account of unusual hot and dry weather the crop matured about one month earlier this year than ordinarily. If the weevil should attack stalks as early in the season on normal years as it has this year, the yield would naturally be expected to suffer from incomplete nourishment. To all appearances, no detrimental effect on this year's product could be charged to any cause other than to weather conditions in support of the claim of undersized ears. The chain of evidence in determining the attacks in green stalks, however, is further strengthened by the maturity of weevils from infested samples placed in a breeding box. At Tallulah, La., on October 1, two adults were found on drying stalks of late planted corn. Although I failed to find any signs of breeding in the stalks, their presence was considered to be for the purpose of oviposition.

As a cotton insect Dr. L. O. Howard has placed the species on record as attacking damaged bolls, and he also points out the principal adult characters by which it can easily be distinguished from the boll weevil, since both insects in one stage or another are sometimes found living in different parts of one boll (12, 13). Its work in this respect is much like a scavenger, or, as Doctor Howard states, a "result, rather than the cause, of the damage." Field observations have failed to bring to my notice any definite evidence of its attack in green bolls. That such instances seem possible in case of partially diseased bolls was indicated by finding at Jackson, Miss., on October 11, an adult hiding in an opening of a boll in which anthracnose had developed sufficiently to cause discoloration of the exposed internal tissues; otherwise the boll was green and unaffected. The intent of this weevil was surmised to be for oviposition, and at the same time to feed upon the decaying tissues. Definite cases of its breeding in bolls have been repeatedly carried through from larva to adult, but in every instance, the infested bolls were old deteriorated, or dried rotten ones, the ravages occurring particularly as a sequence to the disease called anthracnose.

From collections of old cotton bolls gathered by myself at Alexandria and Mansura, La., February 26 to March 2, and by Mr. J. D.

Mitchell at Victoria, Tex., March 7 to 10, the dates being already stated for examination of cornfields, the weevil in all stages, mostly larval, however, was frequently encountered in both hanging and fallen bolls. Many of these bolls, including the seeds, were so completely riddled internally that only the burr prevented them from crumbling into dry powder. Larvæ in these bolls isolated for rearing matured as adults from March 24 until April 14. In the course of examination of the bolls from Alexandria, La., one fallen boll was found to contains a number of live mites with two dead pupæ of *Araecerus fasciculatus*. The gregarious position of these mites within the nearly destroyed pupal bodies at once indicated their predaceous nature. These mites were identified by Mr. Nathan Banks as apparently his species, *Tyroglyphus breviceps*. This species of mite affords additional interest from the fact that it has been known at times to prey upon larvæ of cotton boll weevils in fields at Victoria and Calvert, Tex.

The persistency of *Araecerus fasciculatus* in breeding in old cotton bolls was notably observed this year at Natchez, Miss. Mr. R. A. Cushman found all stages in dried and decayed seeds of bolls which he collected at this place on January 19. During the time of my assignment at Natchez, from May 11 until June 29, for the purpose of recording the appearance of boll weevils in hibernation experiments, adults of the coffee-bean weevil also appeared frequently with boll weevils in cages containing old plants with hanging bolls, and in one instance from Spanish moss alone in the cage. To prove that *Araecerus fasciculatus* actually bred in the bolls at this time, an examination of a number of hanging and fallen bolls gathered from old stalks in an open space adjacent to the cages was made on June 8, and resulted in finding both larval and adult stages, many of the bolls showing severe ravages. A weevil matured in fourteen days from an infested boll placed in isolation.

An important factor which relates to the favorable propagation of the coffee-bean weevil is afforded by berries of the China tree, as formerly mentioned, (27). During my inspection work at Alexandria and Mansura, La., the overwintered Chinaberries also received attention, and the finding of larvæ commonly at work in them denoted a general infestation of the fruit. The abundance of these berries which remained hanging on the trees therefore provided an attractive medium for the breeding of the weevils. Not only as an alternative, but in case of destruction or absolute lack of cornstalks and cotton bolls, the weevil will evidently maintain a prolific multiplication in Chinaberries. Mr. J. D. Mitchell has reported the emergence of an adult weevil from a Chinaberry as early as February 28 at Victoria, Tex. On May

27, at Natchez, Miss., I found two fresh-looking adults clinging to stems of fallen berries, from which they had probably just emerged, and a young larva found at the same time in a berry selected from other infested ones matured June 17 in isolation. Few larvæ were found in old fallen berries at Tallulah, La., on October 1.

An additional food-plant, concerning which no former record is known to me, has been reported by Mr. J. D. Mitchell, who submitted an adult weevil with the statement that it emerged on February 21 from castor bean (*Ricinus communis* Linn.), collected December 21 at Victoria, Tex. At Baton Rouge, La., on April 13, Mr. W. D. Pierce obtained an adult and larva in an old rotten fig, which had been hanging on the tree, but earlier mention of the weevil's depredations in fig products has been made by Mr. E. Barlow with respect to Chinese figs, (1), and by Dr. F. H. Chittenden in regard to fig cakes, (7).

The statement previously made regarding its breeding in beans is applicable to such as possess aromatic properties. Dr. F. H. Chittenden, who bestowed the common name of "Coffee-bean weevil" upon the insect, is the leading authority upon the omnivorous habits of the pest in attacking vegetable substances, (5, 6, 7.) Being transported in tropical products the insect has become cosmopolitan as an indirect result of world-wide traffic, thus accounting for its introduction into the United States. The immature stages, as a rule, are pure white, although generally covered with the fine powdered debris of the burrow; but occasionally in the cornstalks and rarely in cotton bolls pink colored examples of both larvæ and pupæ were found.

Literature Consulted

1. **Barlow, E.** Notes on insect pests from the entomological section, Indian museum. (Indian Museum Notes, IV, No. 3, Govt. India, Dept. Rev. and Agric., 1899, pp. 125–127, pl. XI, fig. 3, larva, pupa, dorsal and side views of adult.)

   Called the areca-nut beetle from its attacks in stored nuts of *Areca catechu*, or betel-nut. Mentioned as attacking coffee-berries, ginger, Chinese figs, etc. Article ends with synonymy by Doctor Gemminger et B. de Harold, Catalogus Coleopterorum.

2. **Beutenmuller, Wm.** On the food-habits of North American Rhyncophora. (Jour. N. Y. Ent. Soc., I, 1893, p. 88.)

   Quotes Mr. E. A. Schwarz's record, see 25.

3. **Blackburn, T., and Sharp, D.** Memoirs on the Coleoptera of the Hawaiian Islands. (Sc. Trans. Royal Dublin Soc., III, ser. II, Feb., 1885, p. 260.)

   "Widely distributed. Common in decaying leaves wherever they are heaped up from any cause, and occasionally beaten from fresh

foliage. Very variable. This insect has no saltatory powers whatever."

4. **Brown, R. E.** Strychnine as food of *Arœocerus fasciculatis* De Geer. (Jour. N. Y. Ent. Soc., XIV, 1906, p. 116.)
Reported breeding in the St. Ignatius bean (*Strychninos ignatii*) in the Philippines.

5. **Chittenden, F. H.** Insects affecting stored cereal and other products in Mexico. (Bull. 4, Tech. Ser., Div. Ent., U. S. Dept. Agric., 1896, p. 30.)
Mentioned as "coffee-bean weevil," with the statement that it is disposed to be omniverous, being known to breed in raw coffee-berries, cacao beans, mace, nutmegs, cotton bolls, the seed pods of the coffee weed (*Cassia*, sp.), and a plant called wild indigo, probably a species of Indigofera. Well known throughout the cotton states and sometimes found in the northern states in articles of commerce.

6. ————. Insects affecting cereals and other dry vegetable foods. (Bull. 4, n. s., Div. Ent., U. S. Dept. Agric., 1896, p 129; also Rev. Ed., 1902, p. 129.)
Name proposed as "coffee-bean weevil." Infesting dried apples, also coffee beans, mace, nutmegs, chocolate beans and roots of ginger.

7. ————. An invasion of the coffee-bean weevil. (Bull. 8, n. s., Div. Ent., U. S. Dept. Agric., 1897, pp. 36–38, fig. 9, larva, pupa and adult.)
The species found to have been introduced in a grocery store of Washington, D. C., from coffee in sacks, the insects afterwards entering boxes of dried fruits and into crackers, especially fig cakes, breeding freely in dried apples. Mentions cotton bolls as food; also all stages in dry orange from Florida. Gives reference to original spelling of generic name.

8. **Fullaway, D. T.** Insects of cotton in Hawaii. (Bull. 18, Haw. Agric. Exp. Sta., 1909, p. 24, fig. 16, larva, pupa and adult of coffee-bean weevil, from Chittenden.) Mentions the species as "found about cotton, probably seeking shelter," and quotes Dr. L. O. Howard's reference.

9. **Giffard, W. M.** Presidential address. (Proc. Haw. Ent. Soc., I, pt. 5, April 8, 1908, p. 181.) Mentioned as an introduced species. "Beaten from Kukui" (*Aleurites moluccana*).

10. **Glover, T.** Entomological record. (Monthly Rept. U. S. Dept. Agric. for August and September, 1872, p. 367, fig. 13, larva and adult.)
Referred to as *Arœocerus coffeæ* Fab. and reported breeding in decaying peaches from Baton Rouge, La.

11. ————. Report of the entomologist and curator of the museum. (Rept. U. S. Com. Agric. for 1872, p. 114, fig. 3, larva and adult.)
Reference same as 10.

12. **Howard, L. O.** The insects which affect the cotton plant in the United States. (Bull. 33, Office Exp. Sta., U. S. Dept. Agric., 1896, p. 348.)
The author in his account of the "Insects Injuring the Boll" says, "Among these the larva of a little weevil, *Arœcerus fasciculatus*, de-

serves especial mention for the reason that it so closely resembles the larva of the Mexican cotton-boll weevil."

13. ————. Insects affecting the cotton plant. (Farmers' Bull. 47, U. S. Dept. Agric., Jan., 1897, p. 29.)

Reference same as 12.

14. **Hunter, W. D., and Hinds, W. E.** The Mexican cotton boll weevil. (Bull. 45, Div. Ent., U. S. Dept. Agric, 1904, p. 49, pl. XV, fig. 62, larva, pupa and adult, from Chittenden.)

Entered in list of "Insects often mistaken for the boll weevil," under the common name of "Coffee-bean weevil," the usual food being given as "coffee beans and old cotton bolls."

15. ————. The Mexican cotton boll weevil: A revision and amplification of bulletin 45, to include the most important observations made in 1904. (Bull. 51, Bu. Ent., U. S. Dept. Agric., 1905, p. 67, pl. XI, fig. 49, larva, pupa and adult, from Chittenden.)

Reference similar to 14.

16. **Koebele, A.** Report of entomologist. (Rept. Com. Agric. and For., Ter. Hawaii, 1900, p. 43.)

"A large number of a very common beetle, *Ardocerus fasciculatus* De G., previously bred on coffee cherries from Waianae, also on seeds of koa, the mamani, and many others; even a seed pod of the kola nut produced quantities of this beetle that will breed equally as well in dead wood."

17. **Perkins, R. C. L.** Coleoptera, Rhyncophora, Proterhinidae, Heteromera and Cioidae. (Fauna Hawaiiensis, II, pt. III, Feb. 8, 1900, p. 182.)

Remarks as follows: "Hab. Abundant all over the islands in the mountains. The large number of constant varieties in markings, as well as the great variation in size of this species is remarkable."

Follows with description of *Arœocerus constans*, sp. nov.

18. ————. Injurious and beneficial insects. (Rept. Gov. Ter. Hawaii, 1902, p. 32.)

"Destroying seeds of many forest trees, e. g., koa, mamani, etc.; also in coffee berries. No natural enemies known here."

19. **Pierce, W. D.** On the biologies of the Rhyncophora of North America. (An. Rept. Neb. St. Bd. Agric. for 1906–07, p. 295.)

Refers to Mr. R. E. Brown's record, see 4, and adds: "This species has many host plants."

20. ————. A list of parasites known to attack American Rhyncophora (Jour. Econ. Ent., I, No. 6, 1908, p. 389.)

Lists the species as one of economic importance and as serving as co-host of boll weevil parasites.

21. **Riley, C. V.** Cotton culture and the insects affecting the plant at Bahia, Brazil. (Amer. Ent., III, May, 1880, pp. 128–129.)

Reports *Arœcerus fasciculatus* in cotton bolls forwarded from Bahia, Brazil, January 12, 1880.*

*A subsequent record in the entomological files of the U. S. Dept. Agric., under accession No. 2218, states that weevils matured in diseased bolls from Bahia, Brazil, November 13, 1882.

22. ————. The final report on the cotton worm, together with a chapter on the boll worm. (Fourth Rept. U. S. Ent. Com., 1885, note 62, p. [121].)

Remarks reproduced from 21.

23. ————. The insects occurring in the foreign exhibits of the World's Columbian Exposition. (Insect Life, Div. Ent., U. S. Dept. Agric., VI, February, 1894, p. 221.)

"Breeding in mace from Trinidad and Johore, and in cocoa beans from Liberia."

24. **Sanderson, E. D.** Insects injurious to cotton. (Insects Injurious to Staple Crops, 1902, pp. 200–201.)

Mentioned as attacking damaged bolls.

25. **Schwarz, E. A.** The Coleoptera of Florida. (Proc. Amer. Phil. Soc., XVII, 1878, p. 469.)

"*Arœocerus fasciculatus*—not rare, raised from the pods of a large yellow flowering shrub belonging to the Mimosaceæ."

26. **Smith, J. B.** Insects of New Jersey. (Supp. 27th An. Rept. St. Bd. Agric. N. J., 1899 [1900], p. 367.)

"Undoubtedly brought into the state on dried fruits and similar stores (Ch)."

27. **Tucker, E. S.** New breeding records of the coffee-bean weevil. (Bull. 64, pt. VII, Bu. Ent., U. S. Dept. Agric., August 5, 1909, pp 61–64, pl. III, work in cornstalks, and fig. 18, larva, pupa and adult, from Chittenden.)

Injury to corn; occurrence in Chinaberries; parasites; habits in general.

28. **Van Dine, D. L.** Report of the entomologist. (An. Rept. Haw. Agric. Exp. Sta. for 1907, p. 48.)

Under subhead of "Stored Products" the following records are given: "A beetle (*Arœocerus fasciculatus*) was bred from the seeds of St. John's bread (*Ceratonia siliqua*) received from Kohala, island of Hawaii. This same beetle was bred from cotton bolls received from Kona, island of Hawaii."

29. **Van Dine, D. L.** Report of the entomologist. (An. Rept. Haw. Agric. Exp. Sta. for 1908, p. 31.)

"A weevil (*Arœocerus fasciculatus*). This weevil was bred from cotton bolls received from Hookena, South Kona, Island of Hawaii, in December, 1905. Determined by Mr. E. A. Schwarz of the Bureau of Entomology."

NURSERY INSPECTION IN NORTH CAROLINA

By FRANKLIN SHERMAN, JR., *Entomologist, State Department of Agriculture, Raleigh, N. C.*

North Carolina does not take high rank as an orchard state, nor does she rank high in the number or average size of her nurseries. There has been an increase in the number of nurseries during the past decade. In 1900 there were forty-five licensed, in 1908 there were sixty-two licensed, but for the present season the number has dropped to fifty-six, with perhaps one or two yet to be added. Every year a few small nurserymen quit for one reason or another, and others start up. Of course our larger nurseries are permanently established and have considerable capital invested, but we probably have a larger proportion of small, temporary nurseries than is found in most states. However, this may be more apparent than real, due to the fact that we have continued the same system and policy of inspection so long that we have located and listed practically all nurseries even to the smallest ones which serve only a local trade and never offer shipments for transit by railways, etc.

We, like others, are frequently vexed to decide just "what is a nursery" and to tell whether this or that person's premises should be inspected. Often the expense and time required to make an inspection are so great as to be out of all proportion to the importance of the end served by it. In accord with the ideas which the writer has advanced at meetings of the horticultural inspectors we are constantly striving to eliminate needless inspections, needless expenses, and needless hampering of trade, as we believe that it is just such matters that cause some nurserymen to condemn the whole system of inspection as useless.

Our system of nursery inspection and control is very far from perfect. While our conditions of work are all that could be desired in almost every other particular, we are handicapped by the fact that we have only one man (Mr. S. C. Clapp of this office) to assign to the inspection work, and our funds are such that we cannot spend as much on the inspections as would be required to absolutely clinch their efficiency. We do not put a man out of business because his stock is infested with San José scale, and we state this fact plainly to our public. We destroy all trees that are seen to be infested in a *careful inspection*, and if the number is very small in comparison to the number of trees involved the nursery is certified. If the number found infested is large enough to throw suspicion on the whole lot

the block is examined *tree by tree,*—or is left over for a second inspection later, the proprietor being fully instructed what he is to do about it in the meantime. There is no charge for the one (first) regular inspection, but when second inspections are necessary there is a sizable fee, graded according to the acreage involved in difficulty, so the whole tendency is for the nurseryman to see to it that a second inspection will not be required. If a block is found to be so infested that even tree by tree inspection would still be insufficient, the block (or part of it) is condemned to complete destruction. Now right here comes a point,—how do we *know* that the condemned stock is destroyed? Well, here we are guided by circumstances. If the block is very small the inspector can cut off every tree row by row with his heavy pocket knife (which is always carried for the purpose); or he can stay on the premises while the laborers do the work of destruction by this means or otherwise. Or if the condemned block is large he may go his way and return later to see that the work has been done. If the nurseryman is one whose whole past record and conduct gives guarantee of his integrity the inspector may leave it to him to destroy the stock, the nurseryman writing us when the work has been done and we take his word for it. In case of doubt about the work having been properly done the inspector makes another visit to make sure.

It should be remembered that all stock of apple, peach, pear, plum, cherry, quince and apricot is required to be fumigated with hydrocyanic acid gas before it is sold from any nursery in the state, and all our nurseries are required to maintain suitable boxes or rooms for the fumigation, and every nurseryman is furnished with explicit printed instructions on the fumigation process, these instructions also indicating the amounts of cyanide, acid and water required for the particular box or room of the nursery to which sent. So the fumigation comes in as an additional safeguard after the other conditions have been met.

It is only in the more important cases that we arrange to have the stock fumigated personally by someone from this office. The great bulk of our nurserymen do their own fumigating, the inspector giving them any needed instructions at time of inspection. It is true that there is chance for stock to be sold without having been fumigated, but we believe that our nurserymen on the whole do reasonably well in meeting this requirement.

Now a word as to the qualifications of the inspector himself. It goes without saying that he should be able to recognize the more important insect and fungous pests that are liable to be in the nursery. We all recognize this as a prime necessity in meeting the *entomological* and *pathological* requirements of the situation. Should he not also be

well acquainted with nursery practices, customs, etc., so as to make only such demands as are practicable from the *nursery* standpoint? We all know that it is difficult to so conduct our inspections and so word our certificates that all kinds of stock shall always be properly covered by certificate,—there is so much of buying and selling, trading, dealing, one nursery growing stock for another, agents carrying over refused stock, etc., etc. I fear that those of us who make our inspections with an eye to their efficiency from the entomological viewpoint solely often make demands of our nurserymen that are well nigh impossible to meet in commercial practice. We are properly sensitive if persons in any other walk of life intrude themselves or their ideas into our affairs, for we maintain that such persons do not know what really is or is not practical in entomological work. Is there not reason for us to be careful that we in looking after the one question of insect pests do not give the nurserymen just cause to resent our inspection work? This idea has grown on the writer year by year,—while we were adhering to the custom of doing the work in person or having only technically trained assistants (college men) to do the inspection work. When it became necessary some two years ago to secure an inspector a young man was selected who had five years' actual experience in a commercial nursery, and who therefore knows the conditions of nursery work and trade, can recognize varieties in the nursery row, and is thoroughly familiar with all the practices common to the nursery business. This man was already familiar enough with San José scale to be a good inspector, and with very little further study and experience has developed into a good all-round man in nursery and orchard inspection work, spraying work, etc. It strengthens our work among the nurserymen if our inspectors show a practical familiarity with the nursery business, in addition to being expert in detecting insect and fungous troubles.

It has been our endeavor to cut out all the immaterial, unimportant details and center our efforts on the main points that are at stake in the nursery inspection, and we have tried to make both our work and its requirements more simple and more effective year by year. We find that the proportion of nurseries found to be infested by San José scale is slowly increasing, and this seems to be inevitably the case through most of the eastern states, but we can at the same time assert that the average condition of the infested nurseries is becoming better year by year.

There are a few who still regard the inspection as a mere matter of form, but they are mostly growers of ornamentals, berries, etc., to whom the inspections do not apply so exactingly, or else they are

uneducated nurserymen who have not yet been brought squarely against the scale problem. The feeling of real respect (not merely tolerance) toward the inspection work in this state was never so great as it is at present.

PLANT LOUSE NOTES, FAMILY APHIDIDAE

By C. P. GILLETTE

Subfamily *Lachninæ*

Phyllaphis fagi L. At Lansing I found this species extremely abundant. Large American beech trees (*Fagus ferruginea*) had more than half their leaves closely rolled in from the sides by the pale yellow apterous form, the individuals of which were very nervous and active when disturbed. Each louse dragged about four long wavy threads of white secretion. No alate examples could be found. At City Park, Albany, a week later, the same species was seen infesting the underside of every leaf upon trees of the European beech (*F. sylvatica*) of both the green and purple varieties, but in no case were the leaves curled at all. I have never seen trees worse infested with plant lice than were these beeches. A few alate lice were taken at Albany. See figure 1.

Lachnus agilis Kalt. From pine leaves in City Park, Albany, New York. Both alate and apterous forms of this louse were taken. Lice very active and difficult to capture. *Winged viviparæ:* Body 1.70, wing 2.12, antenna 1.30, hind tibia 1.60 millimeters in length. Antennæ and all tibiæ set with numerous long stout hairs. For antenna and hind tarsus see figures 2 and 3.

Lachnus sp., near *agilis*. Taken at same place and date as the preceding on spruce. *Alate viviparæ:* Length of body 2.40, antenna 1.12, wing 3.30 millimeters; beak reaching well past 3d pair of coxæ; hairs upon tibiæ and antennæ more numerous than in case of *agilis* but the hairs are much weaker. Joint III with a single row of 4 tuberculate sensoria, IV with 1, V with 2. See figure 4.

Lachnus sp. A very small, powdery species rather common in rows upon pine needles at Washington, D. C. *Alate viviparæ:* Length 1.40, wing 2.34, antenna .90, hind tibiæ .86 millimeters; hairs of antennæ and legs long, pilose and rather abundant. Joint III of antenna with 8 sensoria; IV with 2; V with 1. See figure 5.

Melanoxantherium flocculossum Weed. Taken at Webster, Mass., and Portland, Ore., from the bark of willows. Both alate and apterous viviparæ. The peculiar weak cornicles, small at base, a

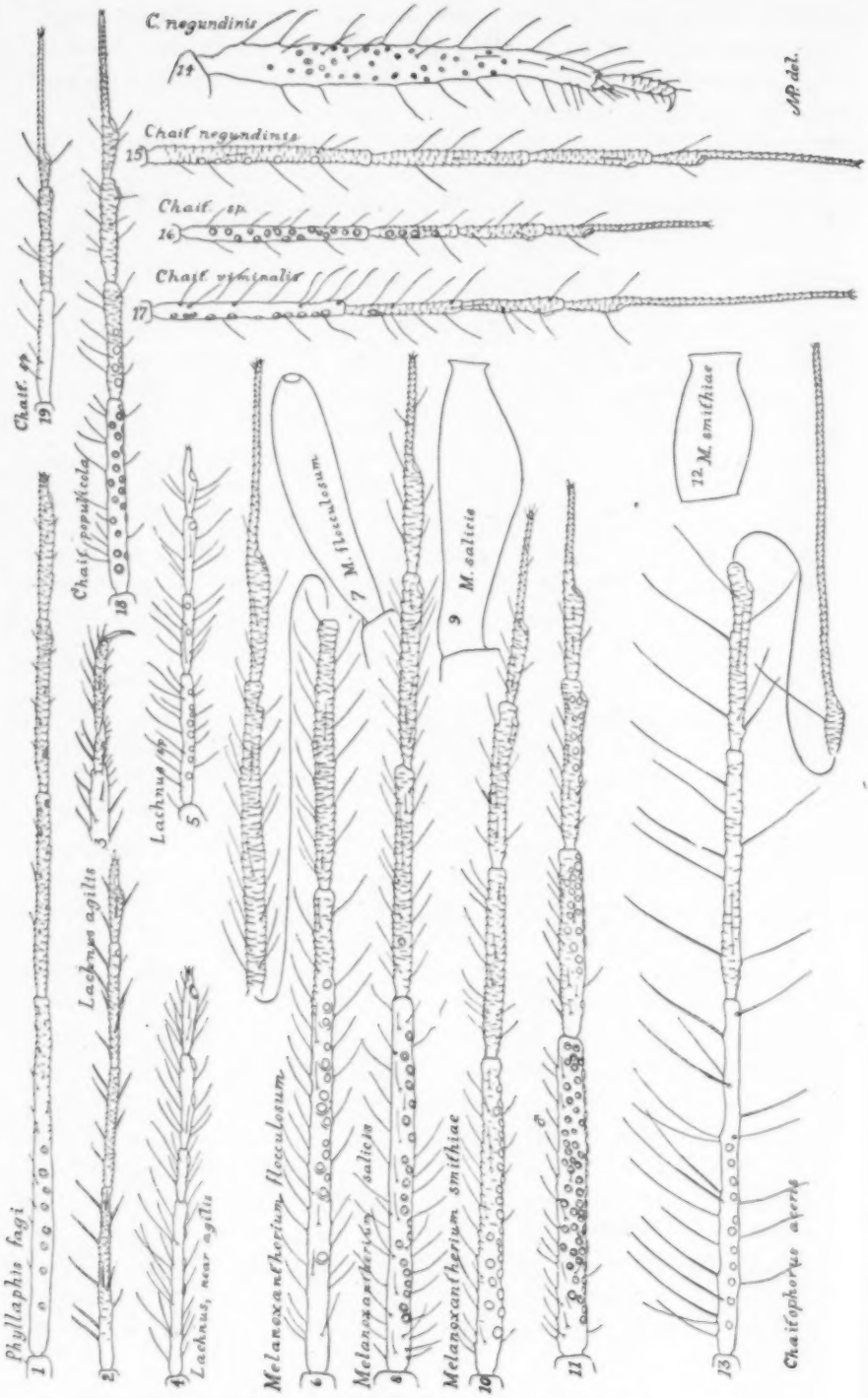

PLATE 13.—Some antennæ, cornicles and tarsi of aphids.

little larger in the middle and tapering to a rounded distal end entirely without flange, and the two longitudinal rows of conspicuous black spots upon the dorsum are striking characters of this large louse. It seems not to occur in Colorado. See figures 6 and 7.

Melanoxantherium salicis Linn. This species was taken by Mr. Bragg at Webster and Springfield, where it was feeding upon the bark of willows. Both alate and apterous viviparæ were in the lots taken. The only record we have for this species in Colorado is upon a few specimens taken by Mr. Bragg at Colorado Springs from willow. In general appearance this louse would be readily mistaken for *smithiæ* Monell. For characters of antennæ and cornicles of alate viviparæ see figures 8 and 9.

Melanoxantherium smithiæ Monell. This bark feeding louse was taken at Webster and Springfield where it was abundant on willow limbs. This is a very common species in Colorado, where it is always found feeding upon the small limbs. It is separated at once from any of the other species of this genus that I have seen by its very stout cornicles which are swollen in the middle and contracted at both ends. See figures 10, 11 and 12.

Chaitophorus aceris Linn. This species, so common upon the leaves of the sugar maple in the Central and Eastern states, I have never seen in Colorado. It was taken at Chicago, Lansing, Detroit, Geneva, Albany and Fort Lee. Both alate and apterous viviparæ were seen in each locality. See figure 13.

Chaitophorus negundinis Thos. This species, which is abundant upon boxelder, *Rulac negundo,* wherever the tree is planted upon both Atlantic and Pacific slopes in Colorado, was taken on this tree at Lansing, Albany, and Webster. Notice the peculiar double sensoria of the hind tibiæ of the oviparous female as shown in figure 14. The antenna of the alate viviparous female is shown at figure 15. The

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EXPLANATION OF PLATE 13.

1. *Phyllaphis fagi*, alate, Albany, July 1; 2 and 3, *Lachnus agilis*, antenna and hind tarsus, Albany, July 1; 4, *Lachnus*, near *agilis*, alate, Albany, July 1; 5, *Lachnus* sp., alate, Washington, July 3; 6 and 7, *Melanoxantherium flocculosum*, alate, Webster, July 16; 8 and 9, *Mel. salicis*, alate, Springfield, July 14; 10, 11 and 12, *Mel. smithiæ*, antenna of alate viviparæ, alate male and cornicle of alate viviparæ, Fort Collins, Colo., September 21; 13, *Chaitophorus aceris*, alate, Chicago, June 23; 14 and 15, *Ch. negundinis*, hind tibia of oviparous female, Fort Collins, November 16, antenna, Fort Collins, June 16; 16, *Chaitophorus* sp., alate viviparæ, Portland, Ore., August 22; 17, *Ch. viminalis*, alate, Georgetown, July 5; 18, *Ch. populicola*, alate, June 26; 19, *Chaitophorus* sp., apterous, Geneva, June 29. All figures enlarged 60 diameters. Original. Miriam A. Palmer, Delineator.

latter was taken November 16, and the former June 16 at Fort Collins, Colorado.

Chaitophorus sp. About Portland, Ore., and especially along the river from Portland to Oregon City, a species of *Chaitophorus* was common upon the leaves of the native vine maple, *Acer circinatum.* The lice seen were mostly apterous viviparæ and dimorphs. The latter were distributed along the main veins of the leaves and upon the wings of the fruit. Most of the dimorphs were decidedly yellow in color but some were growing preparatory to molting and these were quite dark, almost black. Some small very dark lice upon the leaves were probably shed dimorphs.

The apterous viviparæ are very similar to *negundinis* in general appearance except that they are almost black in color.

This louse is certainly not *negundinis* and I can not make it seem possible that it is *aceris.* The antenna is shorter and the filament much shorter in proportion (see fig. 16) and I can not find more than 20 flabellæ in any of the dimorphs, the more common number seems to be 18, or even 16.

Chaitophorus viminalis. At Chicago, Geneva, Webster and Georgetown, both alate and apterous viviparæ were taken upon willow leaves. This species was specially abundant at Geneva. It is an abundant species in the vicinity of Fort Collins almost every year. This species seems to be separated from closely allied forms by the unusually long antennal filament. See figure 17, which shows the antenna of an alate female.

Chaitophorus populicola. Taken at Portland, Michigan and Fort Lee on aspen, *Populus tremuloides.* This is a very abundant species in Colorado, at least to 9,000 feet altitude, upon the cottonwoods and aspens. Upon the aspens in the foothills the apterous viviparæ are almost entirely shining black in color. They often attack the tender ends of twigs in such numbers as to kill both the leaves and new growth. See figure 18.

Chaitophorus sp. A small yellowish green *Chaitophorus* with head a little dusky, was fairly common upon the under side of the leaves of *Malva rotundifolia* on the grounds of the Experiment Station at Geneva. Apterous viviparæ only were seen. The body length varies between 1.10 and 1.25 mm, and the antennæ between .77 and .90 mm in the specimens taken. The species seemed rather sporadic in habit. The antenna of an apterous female is shown at figure 19.

A NEW INSECTARY

By E. DWIGHT SANDERSON, *Durham, N. H.*

At the last annual meeting of the Association of Economic Entomologists[1] the writer led a discussion as to the necessity of a glasshouse insectary for most life history studies. Although appreciating the necessity of a glasshouse for purposes of instruction and for certain classes of entomological investigations he has felt for some time that a structure which would give more natural conditions would be much preferable for most life history work. Carrying out this idea, an insectary was erected by the New Hampshire Agricultural Expermiment Station during the past summer, which is illustrated herewith, and whose construction may be of interest.

It was necessary to build the house on a side hill so that some filling was required and the outer end of the house is several feet above the surrounding area. This is a disadvantage which should be avoided where possible. A stone wall foundation, eighteen inches deep by twelve inches thick, was laid for the base of the entire house, which is thirteen by twenty-four feet. At the head end is a permanent wooden workroom, six by thirteen feet. A door enters from outside on the east side and another opens to the rearing room on the south side. On the north and west sides are windows. This gives ample room for one or two work tables, shelves, storage, etc. The walls are made of seven-eighths boards one foot wide, with three inch battens over the cracks, and the roof is covered with a gravelled roofing paper. All windows and doors are screened.

The rearing room has a cement floor through the center, with six cement pits down one side, and a strip of soil two feet wide along the opposite wall. The floor slants so that water runs out through a drain at the further end. The inside of each pit measures about two feet eight inches square and the outer walls are eighteen inches high. There are no bottoms to the pits so that when filled with soil they are continuous with the soil beneath. The sides of the rearing room are composed of 18-mesh, bronze screens, three feet wide and five feet high, resting on a cement coping, which are buttoned to the uprights which support the roof. The uprights of the sides are bolted to the cement coping and the framework for the roof is fastened together with bolts and screws, so that the whole structure may be taken down, stored for the winter, and readily erected again in the spring. The canvas roof is double, the ridge of the lower one being

[1]Jour. Econ. Ent., II, 59.

about eight feet above the floor and the outer one about eleven feet, giving a one-half pitch. The outer roof is of the heaviest sail cloth, while the inner is of twelve ounce canvas. This arrangement prevents any leaking through the outer roof, on account of the strong pitch, and cuts out the heat of the sun, by the air current between the two. The lower roof also protects the upper from the strain of the wind coming through the screen sides. At the outer gable end the gable is covered by canvas down to the screens. Each roof is really a fly, with a broad seam on each side through which a strip is run and is then screwed to the sides, thus affording a means of tightening the roof should it stretch. After four months, with many heavy winds, the roof shows no signs of wear. The spaces between the upright supports for the roof are filled in between the roofs so that the rearing room is absolutely tight for all ordinary insects too large to pass through an 18-mesh screen.

It is believed that this house affords as nearly natural conditions as possible consistent with an enclosure. Insects which pass the winter in the soil may be reared in cages placed on the pits or in cages on the soil side of the floor, and left there throughout the winter under normal conditions and cages then placed over them when the house is erected in the spring. Many of the details of construction, and indeed the whole house, must be regarded as an experiment, but from the experience of the Bureau of Entomology with more temporary structures in their work at the Gypsy Moth Laboratory at Melrose Highlands, Mass., it is believed that the general principles upon which the house is based are worthy of such a trial as they will now have.

The whole structure cost approximately $400. Of this nearly one-third was for the grading and cement work. About one half of the total cost was for labor and one half for materials. The double roof cost $47. The screens, including two doors and two window screens for the workroom, with the sixteen around the rearing room cost $70. Lumber cost about $50. Where no gradings were necessary and where a house could be built from plans previously developed, ours developed as we progressed, such a house could probably be built for $300. We shall be glad to furnish any further details of structure to any who may be interested.

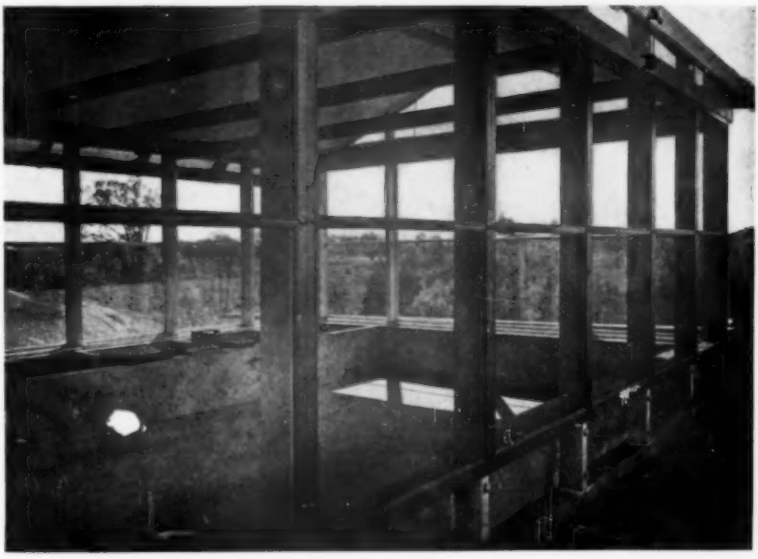


PLATE 14.—Insectary building of New Hampshire Agricultural Experiment Station. A and B strips passing through seams of canvas of upper and lower roof.

THE OBLIQUE-BANDED LEAFROLLER

Archips rosaceana Harris[1]

By E. Dwight Sanderson and Alma Drayer Jackson

In July, 1909, our attention was called to a case of very serious injury caused by the Oblique-banded Leafroller in a large rose house at Madbury, N. H. This is one of the largest rose conservatories in the country, the two houses having a total length of nearly one-half a mile and covering three acres. The roses on one or two benches had been entirely defoliated for over 200 feet as shown in Plate 15. Brief reference to entomological literature gave practically no information of value concerning the pest, so that an investigation was commenced at once. Mrs. Jackson kindly took entire charge of the rearing work and is responsible for the account of it, while the senior author is responsible for the rest of the present article.

History

This insect is an interesting example of one of our best known and much be-written species about which there seems to be but little information. Among the sixty-eight references given in the bibliography, less than a dozen give any very original information of any importance. The great bulk of the literature is mere compilation and quotation from Harris, the original describer. Coquillett seems to have made the most observations upon the species, but not until 1903 were the eggs briefly mentioned by Hart, and no one seems to have observed the stage which passes the winter. The insect has been a common one thruout the United States and, as the bibliography shows, has been noted for over half a century wherever entomologists have been located.

Injury

Serious injury by it has, however, been only occasionally reported. In 1894 Fletcher reported injury to the foliage and young fruit of pears in Ontario. In 1895 Piper noted considerable injury to prunes in Washington. In 1896 Lintner recorded serious injury to apple foliage and by the larvæ gnawing into young apples in eastern and central New York. The same year Lugger reported that Russian apples are sometimes defoliated by the caterpillars in Minnesota. No very serious injury to roses was noted until Chittenden in 1903 mentioned a case in which roses received from Ohio at Libonia, Pa., in

[1]Moths were determined for us by the courtesy of Prof. C. H. Fernald.

May, 1898, were badly infested, though Smith (1896), Davis (1897), and many others had mentioned the rose as one of the common food plants.

In the case under our observation the pest was received on some Killarney plants imported from an Ohio firm something over a year ago. The larvæ evidently increased during the summer of 1908 and by midsummer of 1909 were sufficiently abundant to cause very serious devastation, the loss from defoliation and incidental checking of blooms undoubtedly amounting to over five thousand dollars. Fortunately the infestation started in one corner of the house and though when first observed by us both houses were well infested thruout, defoliation was confined to a relatively small area and the slowness of the spread was rather remarkable. When first observed most of the terminals had been folded up by the larvæ. Subsequent observations show that where the larvæ are not numerous that they are much more common on the lower leaves than on the terminals, this doubtless being due to the fact that the eggs are always laid on the older leaves and never on the terminals. Where plants are badly infested the larvæ tie the terminal leaves together in a typical tortricid fashion, thus checking all growth of the plant, and burrow into the flower buds, so that there is no possibility of securing blooms (Plate 16).

The owner of these houses states that some twenty years ago he was troubled with the same insect in rose houses in Massachusetts, but not so seriously and it was gradually brought under control by handpicking. Upon visiting the Waban Rose Conservatories at Natick, Mass., Mr. Alex. Montgomery, the manager, informed the writer that some twenty years ago when hybrid roses were first introduced that they had had considerable trouble with the insect both in the house and on Jacqueminot roses growing out of doors, but that in recent years, though a few were always to be found in old houses, they had found no difficulty in controlling them by handpicking. Mr. Montgomery had just returned from an extensive trip among rose growers thruout the East, but had heard of no noteworthy damage by the insect in recent years, nor do the florists' trade journals give any account of injury, except that Sirrine (1900) mentions it as a carnation pest, where carnations are with or follow roses, implying that it a common rose pest. It is evident, therefore, that serious injury to roses is sporadic as on the apple, and other common food plants.

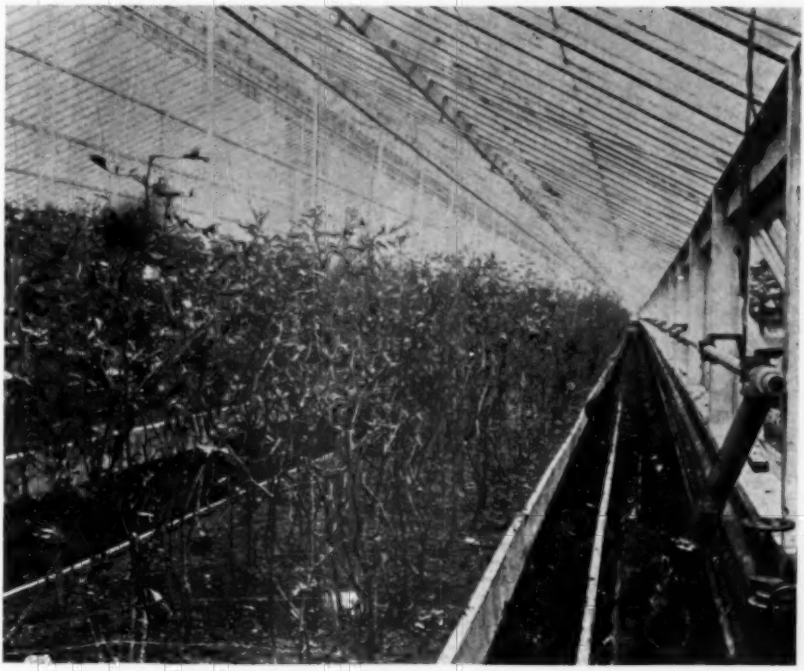


PLATE 15.—Injury in rose house by the Oblique-banded Leaf-roller. The upper view shows the complete defoliation of the plants on the benches seen in the lower view. Photos by W. S. Abbott.

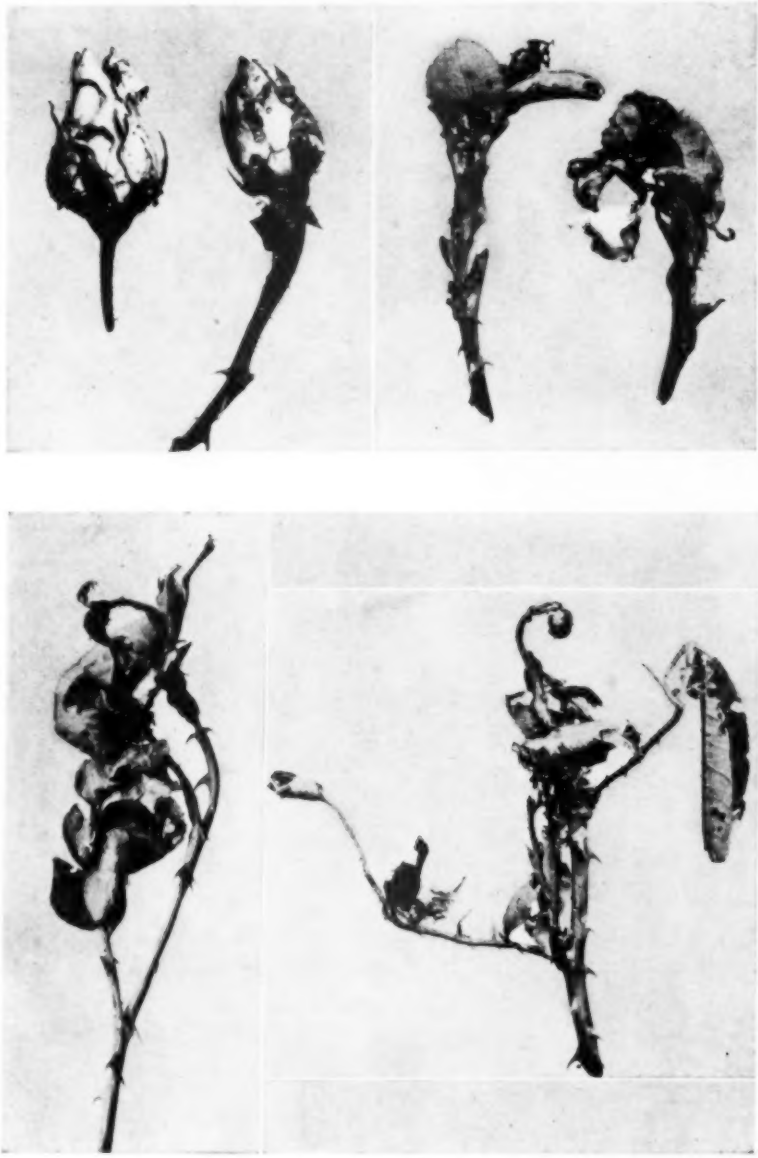


PLATE 16.—Showing injury to terminals and buds of rose by the Oblique-banded Leaf-roller. Photos by W. S. Abbott.

Food Plants

The list of food plants on record comprises over fifty species, as follows:

Gnaws rinds of apples (Walsh & Riley); currant (Perkins); oak (Hart); cotton (Glover, Mally); rose, apple blossoms and leaves, peach, cherry, yellow birch, plum, clover, honeysuckle, beans, strawberry, *Acer negundo, Crataegus, Cornus stolonifera* (C. H. Fernald); *Betula populifolia* (Packard); ash (Forbes); celery (Davis); pear,—leaves and fruit, gooseberry, black currant, garden geranium, silver maple seeds (Fletcher); plums and prunes (Piper); apple—foliage and young fruit (Lintner); Russian apples defoliated (Lugger); roses (Smith, Davis); blackberry (Chittenden); carnations (Sirrine); basswood (Gibson); bred from apple, cherry, Siberian crab-apple, lilac, horsechestnut, raspberry, wild strawberry, wild rose (*Rosa blanda*), burdock (*Lappa officinalis*), thistle (*Circium lanceolatum*), red clover, ragweed, smartweed, knot grass (*P. aviculare*), and found on burr-oak, poplar, hazel, sumac, wild raspberry, wild blackberry, horse radish, wild sunflower (*Helianthus grosseserratus*) and blue vervain (*Verbena hastata*)—Coquillett; elm, beech (C. H. Fernald, mss.).

Distribution

C. H. Fernald gives the distribution as from Maine to California. Dyar gives Northern United States and Colorado. It undoubtedly occurs thruout the United States as the following records indicate. Maine (Harvey, Packard); Massachusetts (Harris); Ontario (Fletcher et al); New York (Lintner); Pennsylvania, Florida, Texas (Robinson); Kansas (Snow); Nebraska (Bruner); Michigan (Cook); Illinois (Coquillett); Minnesota (Lugger); Washington (Piper); Texas (Mally).

Life History

The larvæ appear in spring and attack the young foliage of the apple as soon as it opens, and later the blossoms and young fruit, as originally described by Harris and by numerous subsequent writers. In the northern states the larvæ mature during June. Coquillet is the only writer who has recorded the length of the pupal stage and gives five to sixteen, average nine days, in Illinois. The moths emerge from May 30 in Delaware, as observed by us, until early July in New England. Dates of emergence of moths as recorded are as follows:—Massachusetts, end of June (Harris); Maine, last of July (Harvey); Vermont, early July (Perkins); New York, July 1 (Fitch), at light June 13 (Lintner); Michigan, mid-June (Cook);

Illinois, late June, early July (Hart, Coquillett). Chittenden secured pupæ and moths from Libonia, Pa., May 3, 1898, but these were from greenhouse roses.

The eggs have been mentioned only by Hart, who states that the eggs overlap in flat masses. Emmons stated that on plum the eggs were laid in patches on the bark in June and July and remain there until the next spring, but as he expresses a doubt as to whether the species was really *rosaceana*, there seems no good reason to give credence to this observation, which probably refers to *A. cerasivorana* which has such habits.[1] A second brood undoubtedly occurs thruout the range of the species. Cook mentions a second brood of larvæ in autumn, observing a larva as late as October 5, and Harvey and Hart mention a second brood of larvæ in August. Coquillett reared moths of a second brood in late July and until mid-August in Illinois, Packard reared a moth September 1 in Maine and Harvey states they occur the last of July. Moffat found moths abundant at London, Ont., in late July and early August, and Snow in Kansas on August 9.

A second brood of moths thus give rise to larvæ which work in the fall. Coquillett hazarded the guess that the eggs passed the winter, but this is the only statement as to the hibernation except that Harvey was candid enough to state that nothing was known of the eggs or hibernation of the species. From the fact that the larvæ occur in fall and early spring and that many species of this family pass the winter as larvæ it seems probable, though we have no definite observations on the point, that the larvæ hibernate over winter probably within folded leaves well encased in their own silk, either attached to the tree or on the ground, altho they may hibernate under or attached to the bark. It seems probable that even in a warm greenhouse the majority of larvæ do not transform in the winter, as Mr. Montgomery of Natick, Mass., states that they have never been troubled with them in winter, but that [illegible]n as the spring sunshine warms up the houses they commence t[illegible]. We are now making observations on this point. It will be interesting to determine, as we expect to do, whether more than two generations occur in greenhouses, but our present data does not so indicate.

Observations on the Life History

The following observations on the life history were made during August and early September, 1909. The eggs are laid in round or

[1]Weed. Bulletin 81, N. H. Agr. Exp. Sta., p. 17.

oval, flat, green patches, each containing an average of about 117 eggs, as shown below.

Number of eggs:	10–20.	25–50.	75–100.	100–150.	150–200.	275.	300.	360.
Number of masses:	7.	6.	5.	3.	4.	2.	3.	1.

The table shows plainly the great variance in the number of eggs in one mass, ranging as it does from a very few to over 300. A weighted average of the above gives 117 eggs as the average number laid at one time.

The total number of eggs produced by one pair of moths is an interesting as well as an important feature. For this purpose, single pairs of moths which had just emerged, were isolated and placed in glass cylinders containing fresh rose twigs. As soon as the eggs were noted they were removed and counted. The results were as follows:

Number of eggs laid by individual females: 650, 488, 80, 375, 52, 83, 200, 575, 190, 45, 400, 575.

Averaging the above gives 305 eggs to be the average number laid by one female moth at room temperature having a mean of 70°F. The masses vary considerably in size, four millimeters being a good average width. The eggs are glued together by gelatinous material and often overlap. From our observations in the infested greenhouse and in the insectary they are generally deposited on the older leaves of the plant rather than on the fresh shoots. The egg mass is usually a shade lighter than the green leaf. Oviposition usually takes place at night, although cases have been observed on very cloudy days. Practically all the eggs of a mass hatch at once, leaving the empty shells of the mass whitish in appearance. In case of parasitism the individual eggs are blackened by the pupa of the parasite. The figure in Plate 17 above E is a parasitized egg mass, while the light masses are unparasitized

The time of incubati[illegible]ies considerably according to the temperature. A number [illegible]eshly deposited egg masses were put in vials and placed in an [illegible]ubator kept at 80°F. The length of the egg, larval, and pupal stages were all determined with specimens kept in a glassfront incubator kept constantly at 80°F., which is practically the mean temperatur[illegible] of the rose house in summer. Observations were made every morning from which were obtained the following data:

Number days' incubation.....	5	6	7	8	9
Number of egg masses.....	10	12	11	9	4

From the above experiment 6.67 days is found to be the average

length of time required for the incubation of one egg mass at what is probably an average mean temperature for a rose house in late summer. Another lot of egg masses was left in the room where the temperature averaged 70°F. From these we obtained the following results:—

Number days' incubation	8	9	10	11	12
Number of egg masses	1	6	6	6	3

At this temperature a single egg mass requires 10.18 days incubation and so takes 3.51 days longer to hatch at 70° than at 80°F.

The larvæ when first hatched are extremely minute and closely resemble the leaf in color. They crawl about for three or four days, feeding here and there and growing rapidly. At the end of this period the young larva begins to form a protection for itself by pulling two or three leaves together, or more frequently a young larva will fold over a single leaf forming a tube open at either end. The leaves are held together by silken threads. The larva feeds upon the inside of the tube or makes short excursions to adjacent leaves which are pulled down and attached to the original tube, so that as the larva increases in size it also increases the size of the nest. It was frequently observed that when all the leaves of a particular part of a plant had been destroyed the larvæ would go to another part of the plant and start new nests. This, however, seems to be dependent on food supply. The length of the larval stage may be seen from the following:—

Larval period in days...	22–25.	26–29.	30.	31–35.	36–40.	41–46.
Number of larvæ.....	11.	16.	13.	28.	14.	9.

The average length of the larval stage is thus 32.69 days at 80°F. There is no doubt but that food conditions may very materially influence the length of the larval stage which is probably somewhat shorter than the above figures indicate. Before pupation the larva draws the leaves together more firmly than usual so that they practically form a cocoon, to the silk of which the pupa is attached by the hooks of the cremaster. The average length of the pupal stage may be seen from the following:—

Pupal period in days	5	6	7	8
Number of pupæ	13	23	23	9

This gives 6.41 days as the average of the pupal stage at 80°F. Out of 62 pupæ, 35 were males and 27 females. About 30% of the pupæ failed to transform.

The adults emerge during the night and if not disturbed will remain in the vicinity of the pupal cases throughout the following day. Usually the males may be distinguished from the females not only by their smaller size but also by two round black spots on the thorax (Plate 17, B). Mating occurs shortly after emergence. The length of time between emergence and egg deposition may be seen from the following:—

Days from emergence to oviposition....	1	2	3	4	5	6
Number of females.....	1	2	2	4	1	1

Thus on an average a female oviposits at the end of 3.45 days at the room temperature of 70°F. Egg deposition may not, however, all occur at once, as one moth may deposit several egg masses at different times. The average life of an individual as seen from the following is 14.6 days at 70°F:

Length of life in days.....	11	12	13	14	15	17	20
Number of moths.....	2	6	2	2	2	2	4

Summarizing the life history it is found that at a constant temperature of 80°F. the egg stage is 6.67 days, larva 32.69 days, pupa 6.41 days, and life of moth to oviposition 3 days, giving a total of 48.77 days or seven weeks. The difference in rate of development of the eggs at 70°F. would indicate that the total life cycle at 70° would require over ten weeks. This is about the temperature of a rose house in this latitude in September. After October first the houses have a mean of about 62°, running from 56° at night to 70 to 75° in the day. With this temperature the life cycle would probably require three to four months.

Description

Egg mass. (Plate 17, E.) Round or oval, flat, green patches, generally lighter green than the leaf; laid very close together, frequently overlapping; held together by glutinous material; average number in mass, 117; varying in size from a small dot to one-fourth by one-half inch.

Larva. (Plate 17, F). Generally light green in color, varying in some specimens to a reddish or brownish green; a darker green stripe generally evident along the dorso-mesal line; head round, very dark brown or black mottled with brown; mouthparts lighter brown; anterior portion of clypeus light brown; anteclypeus greenish white; labium green with the exception of the distal portion and a black triangular spot near the base; labial palpi green, first and basal segment black; antennæ of three segments; tip of antennæ dark brown,

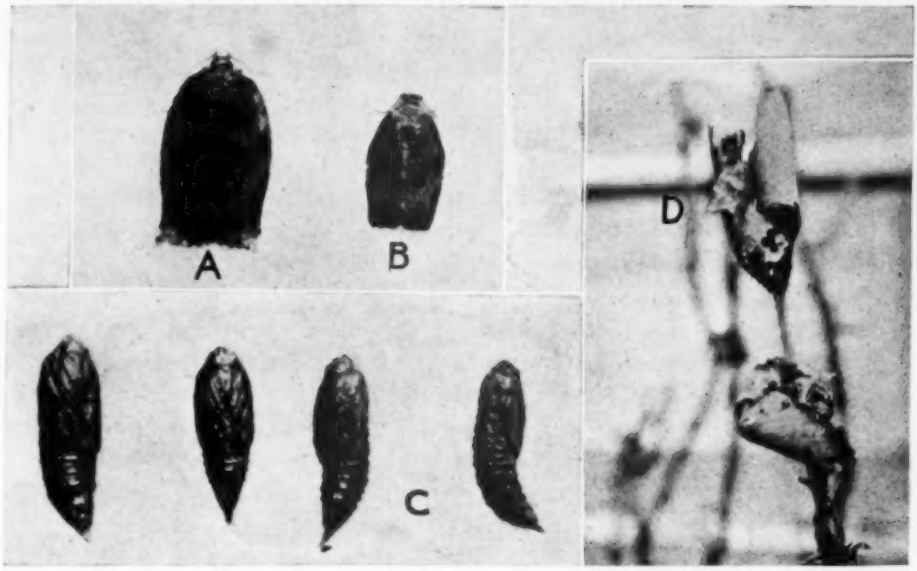
base green; cervical shield brown or greenish brown, posterior border black, a very distinct dorsal suture lighter; two black tubercles on either side midway between ventral border of cervical shield and prothoracic legs, each provided with two long setæ; prothoracic spiracle posterior to the dorsal tubercle; thoracic legs black, first segment concolorous with body; prolegs and anal legs green; anal shield concolorous with body; spiracles circled with brown on each abdominal segment; third to sixth abdominal segments bearing prolegs; yellowish tubercles as follows,—abdominal segments one to eight bear subdorsal tubercles I and II, with single seta, I mesad of II, III just above spiracle and IV–V just below spiracle, VI, VII and VIII as usual; on segment nine II is nearer the meson than I and lies close to the caudal margin, and III just latero-caudad of II; anal segment bears three large sub-dorsal setæ on the caudal half, and a lateral seta on each side; meso- and meta-thorax with a sub-dorsal tubercle bearing two setæ (I), another further latero-cephalad (II), a tubercle with two setæ (III–V ?) in the usual position of the spiracle, and one just caudad of this bearing a single seta (IV); a tubercle in the same position as VI of the abdominal segments further ventrad and apparently homologous; VII and VIII as usual.

Pupa. (Plate 17, C). Light brown just after pupation, becoming much darker with age; lighter on ventral surface; a mid-dorsal dark line beginning with the thorax running the length of the body; the anterior and posterior margins of abdominal segments I to VII inclusive bear a row of short black spines or teeth on both anterior and posterior margins; yellowish setæ are scattered over the body; a decided blackish cremaster nearly twice as long as broad, about equal to the eighth abdominal segment in length, rounded at tip, bearing two strong hooked spines at the tip and one on either side near the tip.

Moth. (Plate 17, A. B.) See Robinson and Clemens (1860) in bibliography.

Natural Enemies

Parasites. It is evident that this species is most effectively held in check by its natural enemies or with so large a list of food plants, wide distribution, and the number of eggs laid, we should have frequent serious outbreaks. What little evidence we have points to the fact that it is held in check by parasites. Coquillett (1882) states that a species of *Glypha* emerges from the larva about the time it should pupate and spins a cocoon from which the parasite emerges 8 to 12 days later; and that in late August, fully one half of the larvæ



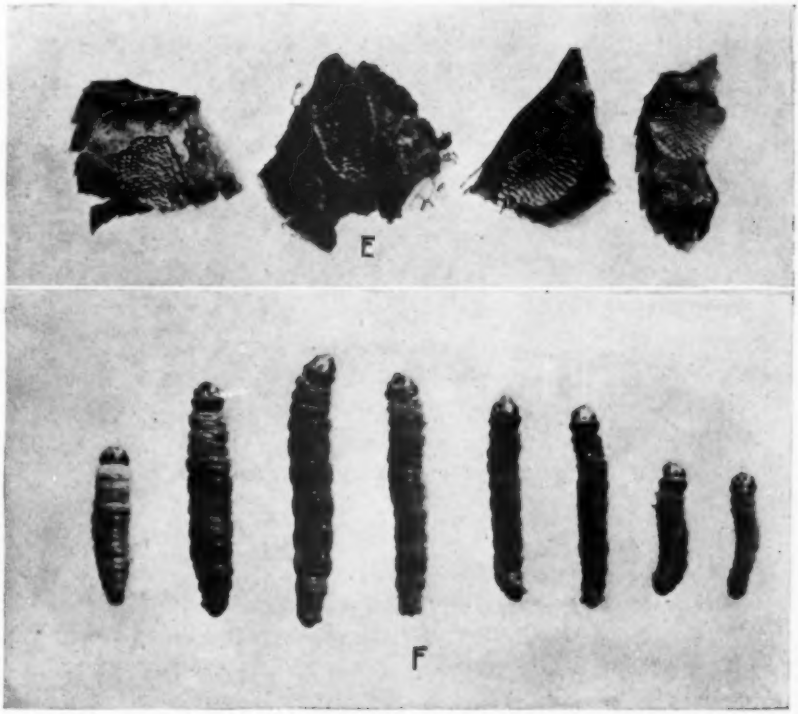


PLATE 17.—A, female moth; B, male moth; C, pupæ; D, moth at rest on foliage, natural size from life; E, egg masses, the one immediately above E full parasitized, the next partially and the one at right unparasitized; F, larvæ—all greatly enlarged. Photos by W. S. Abbott.

are thus parasitized. On some larvæ he observed Tachina fly eggs, and *Perilitus limidiatus* Cresson was reared from one pupa. Cook found that *Glypta simplicipes* Walsh was a very effective parasite of the larvæ and also reared *Microdus laticinctus* from one. Snow reared an unknown tachinid from a larva. Lugger mentions the Baltimore Oriole as a particularly effective enemy of the larvæ.

The outbreak observed by us furnished a case of the most complete parasitism we have ever seen. When first observed in late July from one third to one half of the eggs were parasitized by a species of *Trichogramma*. Two weeks later it was difficult to find an egg mass in which over 95% of the eggs did not contain the black pupæ of the parasite and in most cases 99 to 100% were affected. So effective were the parasites that the control of the outbreak was undoubtedly due to them much more than to any remedial measures.

Remedial Measures

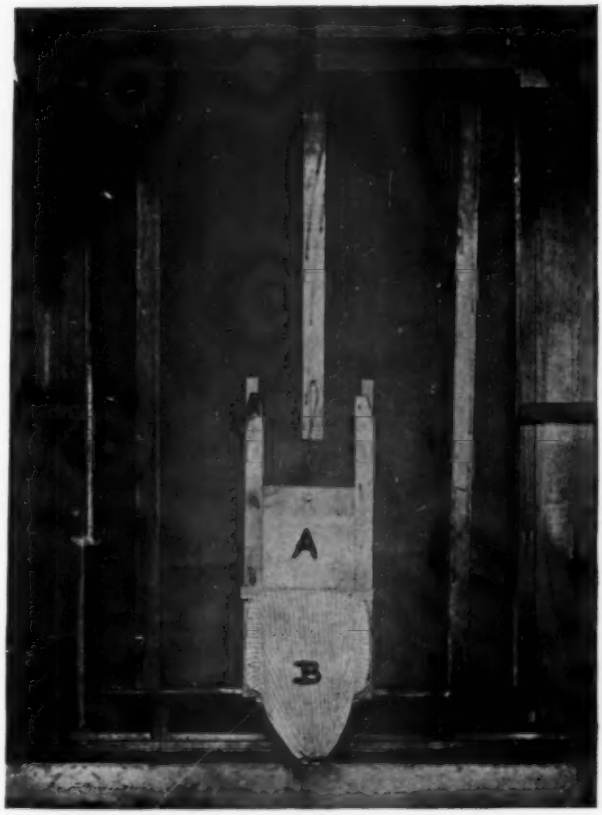
Spraying with arsenate of lead was at once advised by us in the greenhouse above mentioned. The owner hesitated to apply it, however, as it would spot the foliage so as to prevent the sale of any possible blooms, and requested that we experiment with fumigation.

Fumigation. Experiments were, therefore, made at once with hydrocyanic acid gas. For this purpose we had a large box constructed which fitted just inside a window-frame of the insectary workroom. (Plate 18.) This was fastened tightly to the frame, was covered with sheathing paper, all cracks stopped with putty, and the crack between the window sashes plugged with cotton. Thus the box was fully as tight as the average greenhouse. By raising the window from the outside, potted plants could be placed within to test the effect on them and the box could be quickly ventilated. On the inside, a tightly sliding door was fastened and over the opening to the box a canvas sleeve, which was tapered and constricted by an elastic band at the end. With this arrangement, the plants, insects, and acid could be placed in the box through the window on the outside, everything made tight, and the cyanide then poured in from the inside with no possible escape of gas. Furthermore, at any time by inserting one's arm in the sleeve, the sliding door could be raised, a tube containing insects removed, the door then shut, and the tube taken out and subsequently returned in the same way, with practically no loss of gas, thus enabling one to accurately observe the effect on the insects after different lengths of time by having several tubes of insects and taking them out at intervals. The first experiment was made with cyanide at the rate of one ounce to 1200 cubic feet, a rate

often used against aphides by allowing the gas to remain in the house over night, during which time it usually leaks out. In each case several tubes, each containing several specimens of all stages of the insect were used. Though one or two moths and occasionally a larva were killed after three hours exposure, many were alive the next morning, the gas having been generated about 6 p. m. The strength was then doubled to one ounce cyanide to 600 cubic feet, then doubled again, and finally doubled again to one ounce to 150 cubic feet without killing the majority of the larvæ or moths in an hour's exposure, but seriously injuring the plants at the latter strength. Mr. H. F. Hall, formerly horticulturist of this station, who has had extensive experience in greenhouse fumigation, tried similar experiments in a small greenhouse in Massachusetts with the same results. All further experiment with fumigation was therefore dropped.

Arsenate of Lead. Arsenate of lead was then applied to all the plants in the affected houses at the rate of three pounds to the barrel. Many of the worst infested plants were first cut back. This was applied in a novel, but exceedingly effective and practical manner. The tank in which manure water is mixed and the pipes leading from it to all parts of the houses, were flushed out. The arsenate of lead was then mixed up in the tank, hose was attached at each outlet in the houses and when all was ready a score of men commenced spraying, and in an hour and one half the three acres of plants had been thoroughly sprayed without the use of a pump. The application was repeated about a week later. Inasmuch as the eggs are laid on the old foliage and the young larvæ feed upon it, there can be no doubt of the efficacy of arsenate of lead, but its effect was obscured in this case by the almost total parasitism of the eggs. Nevertheless, it probably aided greatly in killing off larvæ and those which hatched from the few unparasitized eggs, for on November 17 larvæ could still be found in some numbers on individual plants here and there. It is questionable whether spraying with arsenate of lead would be desirable on roses except in cases of serious infestation, owing to the spotting of the foliage, but this might be avoided by dusting with dry arsenate of lead. Paris green, dry and sprayed, with and without lime, has been tried by growers in the past, but there is always danger from burning the foliage.

Handpicking. There seems to be no reason why the pest cannot be entirely controlled in rose houses by reasonable diligence in handpicking. This has been practiced for years in some houses where the insect occurs but has never become numerous enough to cause trouble. From our observations we feel that there can be no doubt that hand-



A, sliding door, and B, sleeve over opening to box.
PLATE 18.—Fumigation box seen from inside workroom.

picking so that the insect is never allowed to become abundant enough to warrant spraying or dusting, is by all means the most practical method of control in rose houses. With the removal of the plants and thorough fumigation of the empty houses the pest may thus be easily controlled.

Trap Lights. When the injury was worst, the moths were flying about the house by hundreds, could be picked up beneath every plant, and could be found beneath the benches in the shade in large numbers, often several within a few inches of each other. The owner having observed their attraction to lights, trap lanterns set in pans of water were placed thruout the houses and very large numbers of moths were caught. These lights have been continued during the fall and by the middle of November, fifteen to twenty moths per night were usually caught in the larger house. There can be no doubt of the efficacy of trap lights for this insect in a greenhouse.

For the control of the insect upon apples and other orchard trees, cane and small fruits, and its numerous other food plants, there would appear to be no reason why a thorough application of arsenate of lead to the young foliage and again in midsummer at the time of the emergence of the second brood, should not control it entirely. The determination of its hibernating habits and measures to destroy it in hibernation might also be of value.

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THE GEOGRAPHICAL DISTRIBUTION OF AMERICAN TICKS

By W. A. Hooker, *Washington, D. C.*

In the fourth part of the last memoir of his revision of the ticks, published in 1901, Prof. L. G. Neumann considers their geographical distribution, the species being brought together under the various political divisions of the world in which they are known to occur. The North American species listed are largely based upon the Marx collection of the United States National Museum and the collection of the Bureau of Animal Industry of the United States Department of Agriculture.

Since this account was published there has been an increased activity in the collection of ticks in this country which has resulted in the discovery of many new forms and of a wider distribution of the species recorded than was then known. In Neumann's "Notes sur les Ixodidés," which have followed the "Memoirs," new records have been given which include data on American species. With the appearance of Banks' Revision of the ticks of this country, several new species were described and a number of names were relegated to synonyms through the recognition of Say's and Packard's species. In preparing his "Revision," Mr. Banks examined the collection of the Museum of Comparative Zoölogy, which contains Packard's types,

and had at hand several state collections, as well as the national collections.

In the study of the geographical distribution of the species the writer has attempted to bring these records together. In doing this he has examined the national collections and through the courtesy of Mr. Nathan Banks has also examined his personal collection and been permitted to use the distribution records of the species in the collections which Mr. Banks examined. Most of the records of the species from the different collections are based upon Mr. Banks' determinations. In the following list references are given to Neumann's records, so far as possible to the collections which contain specimens, and occasionally to other records. A list of the abbreviations used will be found appended.

The records of exotic species are largely based upon Neumann's determinations and upon the national collections. References are given to Dr. F. Lahille's records in his work on the ticks of Argentina. Dr. H. B. Aragao, who has studied the Brazilian ticks and described a number of new species, has kindly furnished the writer with a list of the species known to him to occur in that country. The writer wishes to express his gratitude to these workers for the literature and other favors received.

Distribution of American Ticks

NORTH AMERICA—No locality given.

Amblyomma multipunctum (N. 1901).
Ixodes brunneus (N. 1901).

ALASKA.

Ceratixodes putus (B. E. Coll.).
Dermacentor variabilis (N. 1901).
Ixodes angustus (Bks. Coll.).

ALEUTIAN ISLANDS.

Ceratixodes putus (=*hirsutus*) (N. 1901; Bks. Rev.).
Ceratixodes signatus (Bks. Rev.).

PRIBILOF ISLANDS.

Ixodes arcticus (Bks. Rev.; Nat. Mus. Coll.? [Type]).

ST. PAUL ISLAND (Alaska).

Ceratixodes putus (N. 1901 and 1904; Bks. Rev.).

BERING ISLAND (near Aleutian Islands).

Ceratixodes (*Ixodes*) *putus* (=*fimbriatus*) (N. 1901; B. E. Coll.).
Ceratixodes signatus (B. E. Coll.).

ST. PIERRE and MIQUELON ISLANDS (near Newfoundland).

Ceratixodes putus (N. 1901 and 1902).

BAFFIN LAND.

Ceratixodes putus (=*uriæ*) (N. 1901).

LABRADOR.

Amblyomma americanum (N. 1901; Marx Coll.).
Dermacentor variabilis (N. 1901; Bks. Rev.).

NOVA SCOTIA.

Dermacentor albipictus (Pack. Amer. Nat. 1868, p. 559; Pack. Ann. Rep. 1869; Pack. Guide, p. 662).

BRITISH COLUMBIA.

Ceratixodes putus (N. 1904).
Dermacentor albipictus (Bks. Rev.).
Dermacentor venustus (B. E. Coll.).
Ixodes angustus (Bks. Coll.).

ONTARIO.

Ixodes cookei (Bks. Coll.).
Ixodes marxi (Bks. Coll.).

MAINE.

Ixodes cookei (=*hexagonus longispinosus*) (N. 1901; M. C. Z. Coll.; Marx Coll.).

NEW HAMPSHIRE.

Dermacentor albipictus (=*variegatus*) (S. & S. 1901).

VERMONT.

Dermacentor variabilis (B. E. Coll.).
Hæmaphysalis chordeilis (B. E. Coll.; Hadley 1909).

MASSACHUSETTS.

Amblyomma americanum (=*I. unipunctata*) (Pack. Ann. Rep. 1869; Pack. Amer. Nat. 1869, p. 370; Pack. Guide, p. 662).
Dermacentor albipictus (M. C. Z. Coll.) Type.
Dermacentor variabilis (N. 1901; Bks. Coll.; N. Y. S. M. Coll.; M. C. Z. Coll.; Cornell Coll.; Bks. Coll.; Marx Coll.).
Hæmaphysalis chordeilis (Pack. Ann. Rep. 1869; Bks. Rev.) Type locality.
Hæmaphysalis leporis-palustris (N. 1901).
Ixodes brunneus (Mass. A. C. Coll.).
Ixodes cookei (=*H. concinna*) (N. 1901; M. C. Z. Coll. [Type]; Mass. A. C. Coll.).

RHODE ISLAND.

None recorded.

CONNECTICUT.

None recorded.

NEW YORK.

Amblyomma americanum (Bks. Rev.).
Dermacentor nigrolineatus (=*H. concinna*) (N. 1901; M. C. Z. Coll. [Type]; N. Y. S. M. Coll.; Bks. Coll.)
Dermacentor albipictus (=*D. variegatus*) (S. & S. 1901; Bks. Rev.).
Dermacentor variabilis (Stiles Coll.; Cornell Coll.; Bks. Coll.; B. E. Coll.).
Hæmaphysalis chordeilis (B. E. Coll.).
Hæmaphysalis leporis-palustris (N. Y. S. M. Coll.).
Ixodes cookei (=*hexagonus longispinosus*) (N. 1901; N. Y. S. M. Coll.; Cornell Coll.; M. C. Z. Coll.; Marx Coll.; B. E. Coll.).
Ixodes marxi (Cornell Coll.; Bks. Coll.).

NEW JERSEY.

Amblyomma americanum (Leidy 1890, p. 278; Bks. Rev.).
Ixodes cookei (B. E. Coll.; Bks. Rev.).

PENNSYLVANIA.

Amblyomma americanum (=*I. unipunctata*) (Pack. Ann. Rep. 1869; Pack. Amer. Nat. 1869, p. 370; Pack. Guide, p. 662; Bks. Rev.).
Dermacentor variabilis (N. 1901).
Ixodes scapularis or *cookei* (=*ricinus*) (N. 1901).

DELAWARE.

None recorded.

MARYLAND.

Dermacentor variabilis (N. 1901; Stiles Coll.; B. E. Coll.).
Ixodes brunneus (=*frontalis*) (N. 1901; Bks. Rev.).
Ixodes cookei (Bks. Rev.).
Ixodes dentatus (Marx. Coll.) Type.
Ixodes hexagonus (N. 1901; Bks. Rev.).
Ixodes scapularis (Bks. Rev.).

DISTRICT OF COLUMBIA.

Amblyomma americanum (Marx. Coll.; Bks. Coll.).
Dermacentor albipictus (Packard Ann. Rep. 1869).
Dermacentor variabilis (Bks. Coll.; B. E. Coll.).

Ixodes cookei (Marx Coll.).
Ixodes marxi (Marx Coll.).
Margaropus annulatus (N. 1901; Marx. Coll.) Accidental.

VIRGINIA.

Amblyomma americnum (=*A. unipunctata*) (Niles 1900; Bks. Coll.; B. E. Coll.).
Amblyomma maculatum (Niles 1900; H. & H. Bull.; Bks. Rev.).
Dermacentor variabilis (=*Ixodes 5-striatus*) (Fitch 1872; Bks. Coll.).
Hæmaphysalis leporis-palustris (Marx. Coll.).
Ixodes dentatus (Bks. Coll.).
Ixodes scapularis (=*I. ricinus*) (Bks. Coll.; Niles 1900).
Margaropus annulatus (B. A. I. Quar. Area).

CAROLINA. (Not designated.)

Amblyomma maculatum (N. 1901; Bks. Rev.).
Ixodes scapularis (=*ricinus*) (N. 1901).

NORTH CAROLINA.

Amblyomma americanum (Cornell Coll.).
Dermacentor variabilis (B. E. Coll.).
Hæmaphysalis leporis-palustris (Bks. Rev.) Type locality.
Ixodes brunneus (Bks. Coll.).
Ixodes scapularis (Bks. Rev.).
Margaropus annulatus (B. A. I. Quar. Area).

SOUTH CAROLINA.

Ixodes scapularis (M. C. Z. Coll.).
Margaropus annulatus (B. A. I. Quar. Area).

GEORGIA.

Margaropus annulatus (B. A. I. Quar. Area).

FLORIDA.

Amblyomma americanum (N. 1901; Marx Coll.; B. E. Coll.).
Amblyomma cajennense (Marx Coll.).
Amblyomma maculatum (B. E. Coll.).
Amblyomma tuberculatum (N. 1901; Marx Coll. [Type]; Bks. Coll.; B. E. Coll.).
Aponomma inornata (Hook. Notes).
Argas miniatus (S. & S. 1901).
Dermacentor variabilis (Cornell Coll.; B. E. Coll.).
Hæmaphysalis leporis-palustris (B. E. Coll.).
Ixodes scapularis (=*ricinus*) (N. 1901; B. E. Coll.; Bks. Coll.).

Margaropus annulatus (Say 1821; N. 1901; B. A. I. Quar. Area) Type locality.
Ornithodoros talaje (Marx Coll.).
Ornithodoros turicata (=*O. americanus*) (Hubbard 1894; N. 1901; Marx Coll.).

MICHIGAN.

Amblyomma americanum (Mich. A. C. Coll.).
Dermacentor albipictus (Bks. Coll.).
Dermacentor variabilis (Mich. A. C. Coll.).
Ixodes cookei (Mich. A. C. Coll.).
Ixodes marxi (Bks. Coll.).
Margaropus annulatus (Mich. A. C. Coll.) Accidental.

OHIO.

Dermacentor variabilis (Stiles Coll.; Osb. Coll.; Bks. Coll.).
Ixodes marxi (Osb. Coll.; Bks. Coll.).

INDIANA.

Ixodes scapularis (Bks. Coll.).

ILLINOIS.

Margaropus annulatus (N. 1901; Garman Coll.). Accidental.

WEST VIRGINIA.

Dermacentor variabilis (B. E. Coll.).

KENTUCKY.

Amblyomma americanum (Bks. Coll.; Garman Coll.; M. C. Z. Coll.).
Dermacentor variabilis (M. C. Z. Coll.).
Margaropus annulatus (N. 1901; B. A. I. Quar. Area).
Ornithodoros megnini (Garman Coll.; Bks. Coll.).

TENNESSEE.

Amblyomma maculatum (N. 1901; Marx Coll.) Accidental?
Dermacentor variabilis (B. E. Coll.).
Margaropus annulatus (B. A. I. Quar. Area).

ALABAMA.

Amblyomma tuberculatum (Hook. Notes).
Dermacentor variabilis (N. 1901).
Hæmaphysalis leporis-palustris (B. E. Coll.).
Margaropus annulatus (B. A. I. Quar. Area).

MISSISSIPPI.

Margaropus annulatus (B. A. I. Quar. Area).

MINNESOTA.

Dermacentor variabilis (N. 1901).
Hæmaphysalis leporis-palustris (Washb. Coll.).
Ixodes cookei (Washb. Coll.).

WISCONSIN.

Dermacentor nigrolineatus (Bks. Rev.).

IOWA.

Argas miniatus (Marx Coll.).
Dermacentor variabilis (B. E. Coll.).
Ixodes angustus (B. A. I. Coll.; Bks. Rev.).
Ixodes cookei (=*Ixodes hexagonus*) (N. 1901; Marx Coll.).
Ixodes scapularis (M. C. Z. Coll.).
Ornithodoros megnini (M. C. Z. Coll.; Marx Coll.).

MISSOURI.

Amblyomma americanum (M. C. Z. Coll.; B. E. Coll.; Bks. Coll.).
Ixodes scapularis (B. E. Coll.).
Margaropus annulatus (B. A. I. Quar. Area).

ARKANSAS.

Amblyomma americanum (B. E. Coll.).
Dermacentor variabilis (=*Ixodes 5-striatus*) (Fitch 1872).
Margaropus annulatus (N. 1901; B. E. Coll.; B. A. I. Quar. Area).

LOUISIANA.

Amblyomma americanum (Morgan 1899; B. E. Coll.).
Amblyomma maculatum (B. E. Coll.; Newell Coll.).
Dermacentor variabilis (Morgan 1899; B. E. Coll.).
Hæmaphysalis leporis-palustris (Bks. Coll.; B. E. Coll.).
Ixodes cookei (=*I. ricinus* on mink) (Morgan 1899).
Ixodes scapularis (=*I. ricinus* on cattle) (Morgan 1899; B. E. Coll.).
Margaropus annulatus (Morgan 1899; B. E. Coll.; B. A. I. Quar. Area).
Ornithodoros megnini (Bks. Coll.; B. E. Coll.).

NORTH DAKOTA.

Dermacentor variabilis (B. E. Coll.).

SOUTH DAKOTA.

Ixodes cookei (Bks. Coll.).

NEBRASKA.

Dermacentor albipictus (=*D. variegatus*) (S. & S. 1901; N. 1901; Bks. Rev.).
Ornithodoros megnini (S. & S. 1901).

KANSAS.

Dermacentor variabilis (N. 1901).
Hæmaphysalis leporis-palustris (N. 1901).
Ixodes cookei (N. 1901; Marx Coll.; Bks. Coll.).
Ixodes hexagonus (Bks. Rev.).
Ixodes ricinus (N. 1901; Bks. Rev.).
Margaropus annulatus (N. 1901; Marx Coll.).
Ornithodoros megnini (S. & S. 1901).

OKLAHOMA.

Amblyomma americanum (B. E. Coll.).
Dermacentor variabilis (=*Ixodes robertsonii*) (Fitch 1872).
Hæmaphysalis leporis-palustris (B. E. Coll.).
Margaropus annulatus (B. A. I. Quar. Area).
Ornithodoros megnini (Lewis 1908).

TEXAS.

Amblyomma americanum (N. 1901; M. C. Z. Coll.; Cornell Coll.; B. E. Coll.).
Amblyomma cajennense (Marx Coll.; B. E. Coll.).
Amblyomma dissimile (B. E. Coll.) Accidental.
Amblyomma maculatum (N. 1901; B. E. Coll.; Marx Coll.).
Aponomma inornata (B. E. Coll.) Type.
Argas miniatus (N. 1901; B. E. Coll.; Marx Coll.)
Dermacentor bifurcatus (Bks. Rev.) Probably a nymph of some other species.
Dermacentor marginatus (B. E. Coll.).
Dermacentor nigrolineatus (B. E. Coll.).
Dermacentor nitens (B. E. Coll.).
Dermacentor venustus (Bks. Rev.).
Dermacentor occidentalis? (=*reticulatus*) (N. 1901; S. & S. 1901).
Dermacentor variabilis (N. 1901; B. E. Coll.; Bks. Coll.).
Hæmaphysalis chordeilis (B. E. Coll.).
Hæmaphysalis leporis-palustris (N. 1901; Bks. Coll.; B. E. Coll.; Marx Coll.).
Ixodes brunneus (N. 1901).
Ixodes cookei (=*hexagonus longispinosus*) (N. 1901; B. E. Coll.; Marx Coll.).

Ixodes pratti (B. E. Coll.) Type.
Ixodes ricinus (N. 1901; Marx Coll.; B. E. Coll.).
Ixodes scapularis (B. E. Coll.; M. C. Z. Coll.; Bks. Coll.).
Ixodes sculptus (B. E. Coll.).
Ixodes texanus (B. E. Coll.) Type.
Margaropus annulatus (N. 1901; Marx Coll.; B. E. Coll.; B. A. I. Quar. Area).
Ornithodoros megnini (M. C. Z. Coll.; Bks. Coll.; B. E. Coll.).
Ornithodoros talaje (Bks. Coll.; B. E. Coll.).
Ornithodoros turicata (N. 1901; B. E. Coll.; Bks. Coll.).
Rhipicephalus texanus (M. C. Z. Coll.; B. E. Coll. [Type]).

MONTANA.

Dermacentor albipictus (Bks. Rev.).
Dermacentor variabilis ? (N. 1901).
Dermacentor venustus (Bks. Coll.; Stiles Coll.; B. E. Coll.).

WYOMING.

Dermacentor venustus (B. E. Coll.).

COLORADO.

Dermacentor variabilis (N. 1901).
Dermacentor venustus (Bks. Coll.).
Hæmaphysalis leporis-palustris (Marx Coll.).
Ixodes cookei (Marx Coll.).
Ixodes marxi (Marx Coll.).

NEW MEXICO.

Argas miniatus (B. E. Coll.).
Dermacentor occidentalis? (=*reticulatus*) (N. 1901; S. & S. 1901).
Dermacentor variabilis (N. 1901).
Dermacentor venustus (Bks. Coll.).
Ixodes diversifossus (N. 1901; Hass. Coll. [Type]; Bks. Rev.).
Margaropus annulatus (N. 1901; Marx Coll.).
Ornithodoros megnini (Bks. Coll.; B. E. Coll.; Stiles Coll.).
Ornithodoros turicata (Marx Coll.).
Rhipicephalus texanus (B. E. Coll.; Bks. Coll.).

IDAHO.

Dermacentor albipictus (=*variegatus*) (Bks. Coll.).
Dermacentor modestus (B. E. Coll.) Type.
Dermacentor venustus (B. E. Coll.).
Ixodes angustus (N. 1899; B. A. I. Coll. [Type]).
Ornithodoros megnini (Bks. Rev.).

UTAH.

Dermacentor venustus (M. C. Z. Coll.).

NEVADA.

Dermacentor albipictus (=*variegatus*) (N. 1901; S. & S. 1901; Bks. Rev.).
Dermacentor venustus (Stiles Coll.).
Hæmaphysalis leporis-palustris (B. E. Coll.).
Ornithodoros megnini (Marx Coll.; B. E. Coll.).

ARIZONA.

Amblyomma cajennense? (Bks. Coll.).
Argas brevipes (B. E. Coll.) Type.
Argas miniatus (B. E. Coll.).
Dermacentor marginatus (Bks. Coll.) Type.
Dermacentor nitens? (Bks. Coll.).
Dermacentor occidentalis (Osb. Coll.).
Dermacentor parumapertus (Bks. Coll.).
Dermacentor variabilis (N. 1901).
Hæmaphysalis leporis-palustris (Bks. Coll.).
Margaropus annulatus (Bks. Coll.).
Ornithodoros megnini (Marx Coll.; B. E. Coll.).
Ornithodoros turicata (Marx Coll.).

WASHINGTON.

Dermacentor albipictus (=*variegatus*) (N. 1901; S. & S. 1901; Bks. Coll.).
Dermacentor modestus (B. E. Coll.) Type.
Dermacentor venustus (M. C. Z. Coll.; B. E. Coll.; Bks. Coll.).
Ixodes cookei (Bks. Coll.).

OREGON.

Ixodes angustus (B. E. Coll.).

CALIFORNIA.

Amblyomma cajennense (Bks. Rev.).
Amblyomma maculatum (N. 1901; Marx Coll.).
Argas miniatus (N. 1901; Marx Coll.; Bks. Coll.; B. E. Coll.).
Ceratixodes signatus (B. E. Coll.).
Dermacentor occidentalis (=*reticulatus*) (N. 1901; M. C. Z. Coll.; Hass. Coll.; Marx Coll. [Cotype]; B. E. Coll.; Bks. Coll.).
Dermacentor parumapertus (N. 1901; Bks. Coll.; Marx Coll. [Cotype]).

Dermacentor variabilis (N. 1901).
Hæmaphysalis leporis-palustris (N. 1901; B. E. Coll.; Bks. Coll.).
Ixodes æqualis (W. and W. 1909; Bks. Coll. [Type]). Banks' manuscript name.
Ixodes angustus (Bks. Coll.).
Ixodes brunneus (=*kelloggi*) (Bks. Rev.).
Ixodes californicus (Marx Coll.; B. E. Coll.; Bks. Coll. [Type]).
Ixodes pratti (B. E. Coll.; Bks. Rev.).
Ixodes sculptus (Neum. 1904; Marx Coll. [Type]).
Margaropus annulatus (B. E. Coll.; B. A. I. Quar. Area).
Ornithodoros coriaceus (B. E. Coll.; Bks. Coll.).
Ornithodoros megnini (Marx Coll.; B. E. Coll.; Bks. Coll.).
Ornithodoros talaje (Bks. Coll.).
Ornithodoros turicata (M. C. Z. Coll.; Marx Coll.).

HAWAII.

Amblyomma pacificum (N. 1901).
Ornithodoros talaje (N. 1901).
Rhipicephalus sanguineus (B. E. Coll.).

PHILIPPINE ISLANDS.

Amblyomma cyprinum (N. 1901).
Amblyomma decoratum (N. 1901).
Amblyomma dissimile (N. 1901; Marx Coll.).
Amblyomma helvolum (N. 1901).
Aponomma gervaisi (B. E. Coll.).
Margaropus annulatus australis (C. S. Bks. 1904).
Rhipicephalus sanguineus (N. 1901).

MEXICO.

Amblyomma cajennense (N. 1901; Marx Coll.).
Amblyomma coelebs (N. 1901 and 1906).
Amblyomma dissimile (N. 1901; B. E. Coll.).
Amblyomma maculatum (N. 1901).
Amblyomma ovale (N. 1901).
Argas miniatus (N. 1901).
Dermacentor variabilis (N. 1901).
Hæmaphysalis leporis-palustris (N. 1901).
Hyalomma syriacum (N. 1901). Probably accidental.
Ixodes ameivæ (N. 1901).
Ixodes diversifossus (=*bicornis*) (N. 1906; Bks. Rev.).
Ixodes rubidus (N. 1901).
Margaropus annulatus (N. 1901).

Ornithodoros coriaceus (N. 1901; Bks. Rev.).
Ornithodoros megnini (N. 1901; B. E. Coll.; M. C. Z. Coll.).
Ornithodoros talaje (N. 1901).
Ornithodoros turicata (Bks. Rev.).
Rhipicephalus texanus (M. C. Z. Coll.; B. E. Coll.).

GUATEMALA.

Amblyomma americanum (N. 1901).
Amblyomma cnjennense (N. 1901; B. E. Coll.). Common.
Amblyomma dissimile (N. 1901).
Amblyomma sabaneræ (N. 1901).
Amblyomma scutatum (N. 1901).
Amblyomma variegatun (H. 1901).
Amblyomma varium (B. E. Coll.).
Dermacentor nitens (N. 1901).
Ixodes minor (N. 1902).
Margaropus annulatus australis (N. 1901).
Ornithodoros talaje (N. 1901).

HONDURAS.

Amblyomma cajennense (Marx Coll.).
Amblyomma dissimile (N. 1901).
Amblyomma humerale? (B. E. Coll.).
Hyalomma cyclurœ (N. 1901).
Margaropus annulatus (N. 1901; Marx Coll.).
Ornithodoros turicata (B. E. Coll.).

SALVADOR.

None recorded.

NICARAGUA.

Amblyomma cajennense (N. 1901; M. C. Z. Coll.).
Amblyomma crassipunctum (N. 1901).
Amblyomma dissimile (N. 1901; Marx Coll.).
Ixodes (?) *bibroni* (Pack. Ann. Rep. 1869).
Margaropus annulatus (=*Ixodes bovis*) (Pack Ann. Rep. 1869).

COSTA RICA.

Amblyomma cajennense (N. 1901).
Amblyomma fossum (N. 1901).
Amblyomma nodosum (N. 1901).
Dermacentor nitens (B. E. Coll.; Newell Coll.).
Ixodes scapularis (=*affinis*) (N. 1901; Bks. Rev.).
Margaropus annulatus australis (B. E. Coll.; Newell Coll.).

PANAMA.

Amblyomma cajennense (Marx Coll.; B. E. Coll.).
Margaropus annulatus australis (B. E. Coll.).
Rhipicephalus texanus (B. E. Coll.).

BERMUDAS.

Amblyomma cajennense (C. H. T. T. No. 69).

BAHAMAS.

An undetermined larva from a bat (*Phillonycteris sp.*) (B. E. Coll.).

CUBA.

Amblyomma albopictum (N. 1901; B. E. Coll.).
Amblyomma cajennense (N. 1901).
Amblyomma tuberculatum (N. 1901).
Amblyomma or *Hyalomma* sp. (B. E. Coll.). Larvæ only.
Argas miniatus (B. E. Coll.).
Dermacentor nitens (Mayo 1906).
Margaropus annulatus (N. 1901; Marx Coll.; B. E. Coll.; Mayo 1906).
Margaropus annulatus australis (Mayo 1906).
Ornithodoros marginatus (B. E. Coll. [Type]). Bks. Mss. name.
Rhipicephalus bursa (N. 1897).

JAMAICA.

Amblyomma cajennense (N. 1901; Marx Coll.).
Amblyomma maculatum (Marx Coll.).
Argas miniatus (Jo. Inst. Jam. 1897).
Dermacentor nitens (N. 1901; Marx Coll. [Cotype]).
Margaropus annulatus australis (N. 1901; B. E. Coll.).
Ornithodoros turicata (=*O. americanus*) (C. H. T. T. No. 71, Jo. Inst. Jam., vol I).
Rhipicephalus bursa americanus (N. 1901).

HAITI.

Amblyomma cruciferum (N. 1901).
Dermacentor nitens (N. 1901; M. C. Z. Coll.).
Rhipicephalus bursa (N. 1901).
Rhipicephalus texanus (M. C. Z. Coll.).

SAN DOMINGO.

Dermacentor nitens (N. 1897).

PORTO RICO.

Amblyomma cruciferum (B. E.Coll.). On Mona Island.
Aponomma gervaisi? (B. E. Coll.). Isabel Island (Porto Rico? or Galapagos Island?).
Margaropus annulatus australis (B. E. Coll.).

ST. CHRISTOPHER (ST. KITTS).

Amblyomma variegatum (B. E. Coll.).

ANTIGUA.

Amblyomma dissimile (C. H. T. T. No. 69; Jo. Inst. Jam. I, 1893).
Amblyomma variegatum (N. 1901).
Argas miniatus (N. 1901).
Margaropus annulatus australis (N. 1901).
Rhipicephalus sanguineus (N. 1901).

GUADELOUPE.

Amblyomma hirtum (N. 1906).
Amblyomma variegatum (N. 1901).
Hyalomma ægyptium (N. 1901).
Margaropus annulatus australis (N. 1901).

DOMINICA.

Margaropus annulatus australis (B. E. Coll.).
Rhipicephalus sanguineus (N. 1901).

MARTINIQUE.

Argas miniatus (Sim. Aub. and Noc. 1909).

BARBADOS.

Amblyomma dissimile (N. 1901; Marx Coll.).

TRINIDAD.

Amblyomma dissimile (N. 1902).
Argas miniatus (B. E. Coll.).
Dermacentor nitens (B. E. Coll.).
Hyalomma longirostre (N. 1901).
Margaropus annulatus australis (B. E. Coll.).
Rhipicephalus sp. (C. H. T. T. No. 69).

CURACAO ISLAND (Near VENEZUELA).

Rhipicephalus bursa (N. 1901).

TRINITE?

Amblyomma cajennense (N. 1901).

SOUTH AMERICA.

Amblyomma strobeli (N. 1901).
Ixodes (?) *bibroni* (N. 1901).
Ixodes fuscomaculatus (N. 1901).
Ixodes perpunctatus (N. 1901).

COLOMBIA.

Amblyomma cajennense (N. 1901).
Amblyomma diminutivum (N. 1901).
Amblyomma dissimile (N. 1901).
Amblyomma geayi (N. 1901).
Amblyomma striatum (N. 1901).
Argas chinche (N. 1901).
Ixodes juvensis (N. 1901).
Ornithodoros rudis (N. 1901).
Ornithodoros talaje (N. 1901).
Rhipicephalus sanguineus (N. 1901).

VENEZUELA.

Amblyomma cajennense (N. 1901; B. E. Coll.).
Amblyomma dissimile (N. 1901).
Amblyomma bispinosum (N. 1906).
Hyalomma longirostre (N. 1901).
Ornithodoros talaje (N. 1901).
Ornithodoros turicata (Marx Coll.).

GUIANA. (Not designated.)

Amblyomma americanum (N. 1901).
Amblyomma cajennense (N. 1901).
Amblyomma dissimile (N. 1901).
Amblyomma goldii (N. 1901) .
Amblyomma grossum (N. 1901).
Amblyomma oblongoguttatum (N. 1901).
Margaropus annulatus australis (N. 1901).
Rhipicephalus sanguineus (N. 1901 and 1902).

BRITISH GUIANA.

Argas miniatus (N. 1901). Demerara.
Margaropus annulatus australis (C. H. T. T. No. 69).

DUTCH GUIANA.

None recorded.

FRENCH GUIANA.

Amblyomma cajennense (N. 1899).

ECUADOR.

Amblyomma incisum (N. 1906).
Amblyomma maculatum (N. 1901).
Amblyomma pilosum (N. 1901).
Argas magnus (N. 1901).
Ixodes fossulatus (N. 1901).
Ixodes thoracicus (N. 1901). Punta Arenas?

GALAPAGOS ISLANDS.

Amblyomma pilosum (=*hirtum*) (Bks. 1902; N. 1899 and 1906).
Argas transversa (Bks. 1902).

PERU.

Amblyomma maculatum (N. 1901).
Argas cucumerinus (N. 1901).

BOLIVIA.

Amblyomma cælebs (N. 1906).
Amblyomma incisum (N. 1906).
Amblyomma oblongoguttatum (N. 1901).
Amblyomma parvitarsum (N. 1901).
Amblyomma scalpturatum (N. 1906).
Ixodes boliviensis (N. 1904).

BRAZIL.

Amblyomma albopictum (N. 1901).
Amblyomma americanum (N. 1901).
Amblyomma auriculare (Aragoa 1908).
Amblyomma brasiliense (Aragao 1908).
Amblyomma cajennense (N. 1901; Aragao 1908).
Amblyomma cajennense parviscutatum (N. 1901 and 1905; Aragao 1908).
Amblyomma calcaratum (N. 1901).
Amblyomma concolor (N. 1901; Aragao 1908).
Amblyomma denticulatum (N. 1901).
Amblyomma dissimile (N. 1901; Aragao 1908).
Amblyomma fossum (Aragao 1908).
Amblyomma fulvum (N. 1901).
Amblyomma geayi (N. 1901; Aragao 1908).
Amblyomma goldii (N. 1901).
Amblyomma humerale (N. 1901; Aragao 1908).
Amblyomma incisum (Aragao 1908).
Amblyomma infumatum (N. 1901).
Amblyomma longirostre (Aragao 1908).

Amblyomma lutzi (Aragao 1908).
Amblyomma maculatum (N. 1901; Aragao 1908).
Amblyomma naponensis (M. C. Z. Coll.) Type.
Amblyomma nodosum (N. 1901; Aragao 1908).
Amblyomma oblongoguttatum (N. 1901).
Amblyomma parvum (Aragao 1908).
Amblyomma perpunctatus (M. C. Z. Coll.) Type.
Amblyomma pictum (N. 1906).
Amblyomma rotundatum (N. 1901).
Amblyomma scalpturatum (N. 1906).
Amblyomma scutatum (N. 1901).
Amblyomma striatum (N. 1908).
Amblyomma varium (N. 1901; Aragao 1908).
Argas miniatus (March. and Salimb. 1903; Aragao 1908).
Hæmaphysalis cinnaberina (N. 1901; Aragao 1908).
Hæmaphysalis kochi (Aragao 1908).
Hæmaphysalis sanguinolenta (N. 1901).
Hyalomma longirostre (N. 1901).
Ixodes fuscipes (N. 1901; Aragao 1908).
Ixodes imperfectus (N. 1901).
Ixodes loricatus (N. 1901; Aragao 1908).
Ixodes thoracicus (N. 1901).
Ixodes variolatus (N. 1901).
Margaropus annulatus australis (N. 1901; Aragao 1908).
Ornithodoros megnini (Marx Coll.).
Ornithodoros talaje (Marx Coll.).
Rhipicephalus sanguineus (Aragao 1908).

PARAGUAY.

Amblyomma cajennense (N. 1901).
Amblyomma calcaratum (N. 1901).
Amblyomma dissimile (N. 1901).
Amblyomma maculatum (N. 1901).
Amblyomma ovale (N. 1901).
Amblyomma scutatum (N. 1901).
Margaropus annulatus australis (N. 1901; B. E. Coll.).
Ornithodoros coriaceus (N. 1901).

URUGUAY.

Amblyomma gypsatum (N. 1901).
Amblyomma maculatum (N. 1901).
Margaropus annulatus australis (N. 1901).

ARGENTINA.

Amblyomma auricularis (N. 1901; Lah. 1905).
Amblyomma cajennense (Lah. 1905).
Amblyomma dissimile (B. E. Coll.).
Amblyomma fossum (N. 1901; Lah. 1905).
Amblyomma maculatum (N. 1901; Lah. 1905).
Amblyomma testudinis (=*argentinæ*) (N. 1905; Lah. 1905).
Amblyomma varium (N. 1901; Lah. 1905).
Ceratixodes putus (Lah. 1905).
Dermacentor triangulatus (N. 1901).
Hæmaphysalis lagotis (Lah. 1905).
Ixodes loricatus (N. 1901; Lah. 1905).
Ixodes sp. (not *angustus*) (N. 1901; Bks. Rev.).
Margaropus annulatus australis (N. 1901; Lah. 1905).

CHILE.

Amblyomma inflatum (N. 1901).
Amblyomma maculatum (N. 1901).
Amblyomma parvitarsum (M. C. Z. Coll.).
Amblyomma varium (N. 1901).
Hæmaphysalis lagotis (N. 1901).
Margaropus annulatus australis (N. 1905).
Ornithodoros reticulatus (N. 1901).
Ornithodoros talaje (N. 1901).

PATAGONIA.

Amblyomma parvitarsum (Neum. 1901).
Aponomma lævе (N. 1901).

CAPE HORN.

Ceratixodes putus (N. 1901 and 1904).

TERRE DEL FUEGO.

Ceratixodes putus (N. 1902).
Ixodes auritulus (N. 1904).
Ixodes loricatus (N. 1901).

It is hoped that most of the records based upon mistaken identifications have been eliminated. There are, however, several records which have been included that the writer considers questionable. These have been followed by interrogation points. The records of *Amblyomma cajennense* and *Dermacentor nitens* from Arizona are based upon specimens in Mr. Banks' collection which were found in a jar with *Margaropus annulatus*, with a label to the effect that they had

been taken from jack rabbits at Fort Bowie. The fact that *M. annulatus* does not attach to this host and that *D. nitens* has not been recorded from the rabbit is in the writer's opinion sufficient to regard these records with doubt. As no proof of the occurrence of *Argas reflexus* in this country has as yet been brought forth, the species is omitted from the list.

Neumann's records of the occurrence of the species of Dermacentor and Ixodes have been changed to agree with Banks' Revision so far as possible; in a number of instances there has been a question as to the species which he had at hand.

A Locality List of the Species Which Occur in the United States

AMBLYOMMA AMERICANUM (LINNAEUS, 1758).

Type locality: Pennsylvania or New Jersey.

Labrador, Massachusetts, New York, New Jersey, Pennsylvania, District of Columbia, Virginia, North Carolina, Florida, Michigan, Kentucky, Missouri, Arkansas, Louisiana, Oklahoma, Texas, Guatemala, Guiana, Brazil.

AMBLYOMMA CAJENNENSE (FABRICIUS, 1794).

Type locality: Cayenne (French Guiana).

Florida, Texas, Arizona, California, Mexico, Guatemala, Honduras, Nicaragua, Costa Rica, Panama, Bermudas, Cuba, Jamaica, Trinite, Colombia, Venezuela, French Guiana, Brazil, Paraguay, Argentina.

AMBLYOMMA DISSIMILE (KOCH, 1844).

Type locality: Mexico.

Texas (accidental), Mexico, Philippine Islands, Guatemala, Honduras, Nicaragua, Antigua, Barbados, Trinidad, Colombia, Venezuela, Guiana, Brazil, Paraguay, Argentina.

AMBLYOMMA MACULATUM (KOCH, 1844).

Type locality: Carolina.

Virginia, Carolina (North or South), Florida, Tennessee, Louisiana, Texas, California, Mexico, Jamaica, Ecuador, Peru, Brazil, Paraguay, Uruguay, Chili, Argentina.

AMBLYOMMA TUBERCULATUM (MARX, 1894).

Type locality: Florida. Type in the Marx collection.

Florida, Alabama, Cuba.

APONOMMA INORNATA (BANKS, 1909).

Type locality: Texas. Types in the B. E. collection.

Florida, Texas.

ARGAS BREVIPES (BANKS, 1908).

Type locality: Arizona. Types in the B. E. collection.

Arizona.

ARGAS MINIATUS (KOCH, 1844).

Type locality: Demerara (British Guiana).

Florida, Iowa, Texas, New Mexico, Arizona, California, Mexico, Cuba, Antigua, Martinique, Trinidad, Guiana, Brazil.

CERATIXODES PUTUS (CAMBRIDGE, 1876).

Type locality: Kerguelen Island. (Antarctic Ocean.)

Alaska, Aleutian Islands, St. Paul Island, Bering Island, St. Pierre and Miquelon Islands, Baffin Land, British Columbia, Argentina, Cape Horn, Terre del Fuego.

CERATIXODES SIGNATUS (BIRULA, 1895).

Type locality: Unalaska Islands. Cotype? in Banks' collection

Aleutian Islands, Bering Island, California.

DERMACENTOR ALBIPICTUS (PACKARD, 1869).

Type locality: District of Columbia and Nova Scotia.

Nova Scotia, British Columbia, New Hampshire, Massachusetts, New York, District of Columbia, Michigan, Nebraska, Montana, Idaho, Nevada, Washington.

DERMACENTOR MARGINATUS (BANKS, 1908).

Type locality: Arizona. Types in Banks' collection.

Texas, Arizona.

DERMACENTOR MODESTUS (BANKS, 1909).

Type locality: Idaho and Washington. Types in the B. E. collection.

Idaho, Washington.

DERMACENTOR NIGROLINEATUS (PACKARD, 1869).

Type locality: New York. Type in M. C. Z. collection.

New York, Wisconsin, Texas.

DERMACENTOR NITENS (NEUMANN, 1897).

Type locality: Jamaica and San Domingo. Cotype in Marx collection.

Texas, Arizona?, Guatemala, Costa Rica, Cuba, Jamaica, Haiti, San Domingo, Trinidad.

DERMACETOR OCCIDENTALIS (NEUMANN, 1905).

Type locality: California. Cotype in Marx collection.

Texas?, New Mexico?, Arizona, California.

DERMACENTOR PARUMAPERTUS (NEUMANN, 1901).

Type locality: California. Type in Marx collection.

Arizona, California.

DERMACENTOR VARIABILIS (SAY, 1821).

Type locality: Not recorded. Type lost.

Alaska, Labrador, Vermont, Massachusetts, New York, Pennsylvania, Maryland, District of Columbia, Virginia, North Carolina, Florida, Michigan, Ohio, West Virginia, Kentucky, Tennessee, Alabama, Minnesota, Iowa, Louisiana, North Dakota, Kansas, Oklahoma, Texas, Montana?, Colorado, New Mexico, Arizona, California, Mexico.

DERMACENTOR VENUSTUS (BANKS, 1908).

Type locality: Northwestern United States. Types in Marx collection.

British Columbia, Texas, Montana, Wyoming, Colorado, New Mexico, Idaho, Utah, Nevada, Washington.

HAEMAPHSALIS CHORDEILIS (PACKARD, 1869).

Type locality: Massachusetts.

Vermont, Massachusetts, New York, Texas.

HAEMAPHYSALIS LEPORIS-PALUSTRIS (PACKARD, 1869).

Type locality: North Carolina.

Massachusetts, New York, Virginia, North Carolina, Florida, Alabama, Minnesota, Louisiana, Kansas, Oklahoma, Texas, Colorado, Nevada, Arizona, California, Mexico.

IXODES AEQUALIS (BANKS' MSS.).

Type locality: California. Type in Banks' collection.

California.

IXODES ANGUSTUS (NEUMANN, 1899).

Type locality: Idaho. Type in B. A. I. collection.

Alaska, British Columbia, Iowa, Idaho, Oregon, California.

IXODES ARCTICUS (OSBORN, 1899).

Type locality: Pribilof Islands. Type (in Nat. Mus. collection) mislaid.

Pribilof Islands.

IXODES BRUNNEUS (KOCH, 1844).

Type locality: North America.
Massachusetts, Maryland, North Carolina, Texas, California.

IXODES CALIFORNICUS (BANKS, 1904).

Type locality: California. Type in the B. E. collection.
California.

IXODES COOKEI (PACKARD, 1869).

Type locality: Massachusetts. Types in M. C. Z. collection.
Ontario, Maine, Massachusetts, New York, New Jersey, Pennsylvania?, Maryland, District of Columbia, Michigan, Minnesota, Iowa, Louisiana, South Dakota, Kansas, Texas, Colorado, Washington.

IXODES DENTATUS (NEUMANN, 1899).

Type locality: Maryland. Type in Marx collection.
Maryland, Virginia.

IXODES DIVERSIFOSSUS (NEUMANN, 1899).

Type locality: New Mexico. Type in Hassall collection.
New Mexico, Mexico.

IXODES HEXAGONUS (LEACH, 1815).

Type locality: Europe.
Maryland, Kansas, Europe.

IXODES MARXI (BANKS, 1908).

Type locality: Several of the states. Type in Banks' collection.
Ontario, New York, District of Columbia, Michigan, Ohio, Colorado.

IXODES PRATTI (BANKS, 1908).

Type locality: Texas and California. Types in the B. E. collection.
Texas, California.

IXODES RICINUS (LINNAEUS, 1758).

Type locality: Sweden.
Kansas, Texas, California?, Europe.

IXODES SCAPULARIS (SAY, 1821).

Type locality: Not recorded. Type lost.
Pennsylvania?, Maryland, Virginia, North Carolina, South Carolina, Florida, Indiana, Iowa, Missouri, Louisiana, Texas, Costa Rica.

IXODES SCULPTUS (NEUMANN, 1904).

Type locality: California. Type in Marx collection.
Texas, California.

IXODES TEXANUS (BANKS, 1909).

Type locality: Texas. Type in the B. E. collection.

Texas.

MARGAROPUS ANNULATUS (SAY, 1821).

Type locality: Florida. Type lost.

District of Columbia (accidental), Virginia, North Carolina, South Carolina, Georgia, Florida, Michigan (accidental), Illinois (accidental), Kentucky, Tennessee, Alabama, Mississippi, Missouri, Arkansas, Louisiana, Kansas (accidental), Oklahoma, Texas, New Mexico, Arizona, California, Mexico, Cuba.

ORNITHODOROS CORIACEUS (KOCH, 1844).

Type locality: Mexico.

California, Mexico, Paraguay.

ORNITHODOROS MEGNINI (DUGES, 1883).

Type locality: Mexico.

Kentucky, Iowa, Louisiana, Nebraska, Kansas, Oklahoma, Texas, New Mexico, Idaho, Nevada, Arizona, California, Mexico, Brazil.

ORNITHODOROS TALAJE (GUERIN, 1849).

Type locality: Guatemala.

Florida, Texas, California, Mexico, Hawaii, Guatemala, Colombia, Venezuela, Brazil, Chili.

ORNITHODOROS TURICATA (DUGES, 1883).

Type locality: Mexico.

Florida, Texas, New Mexico, Arizona, California, Mexico, Honduras, Jamaica, Venezuela.

RHIPICEPHALUS TEXANUS (BANKS, 1908).

Type locality: Texas. Types in the B. E. collection.

Texas, New Mexico?, Mexico, Panama, Haiti.

While these lists come far from recording the actual distribution of many of the species and include records of accidental distribution of others, it is at once evident that they are more or less limited to climatical zones, being most abundant in the Lower Austral and Tropical Zones and least so in the Boreal Zone. *M. annulatus, A. cajennense, A. maculatum, D. nitens* and *A. miniatus* appear to be limited to the Tropical and Lower Austral Zones; *A. tuberculatum* to the Tropical and Gulf Strip of the Lower Austral Zones, while *A. dissimile* only occurs in the Tropical Zone. Our two species of

Ceratixodes (*putus* and *signatus*) apparently occur in the Boreal Zone only. Many of the species which occur in this country appear to be limited to the Transitional and Austral Zones, but a more extensive collection is necessary to determine their exact distribution.

The host relations of ticks are an important factor to be considered in the study of their geographical distribution. Some species remain attached for long periods and can be carried great distances. The males in many species remain upon the host long after the females, which attached at the same time, have dropped. Many records have been based upon such accidental introduction of the species with the host and should not be considered in determining the normal distribution of the species. Unless the species can reproduce itself and continue reproduction from year to year it should be looked upon as an accidental introduction and temporary resident. In such instances man is usually responsible for the introduction, which is largely upon domestic animals. Thus *Margaropus annulatus* has frequently been introduced into the northern states, where it can reproduce during the summer, but is killed by the cold of winter. It was found by Banks in a collection from Michigan, where it had been taken from ponies. *Amblyomma dissimile*, which was introduced into Brownsville, Texas, from the Isthmus of Tehuantepec, on iguanas, is another instance of an accidental introduction which will probably fail to become established.

A more extensive collection will undoubtedly show a much wider distribution and common occurrence of many of the species here recorded. For the present the determination of their normal distribution must be based upon the frequence of their occurrence, particularly that of females.

Explanation of Abbreviations

Aragao 1908.=Included in a list of Brazilian ticks furnished the writer by Dr. Henrique B. Aragao.

B. A. I. Coll.=In the collection of the Bureau of the Animal Industry, U. S. D. A.

B. A. I. Quar. Area=Included in the area quarantined by the Bureau of Animal Industry, U. S. D. A.

B. E. Coll.=In the collection of the Bureau of Entomology, U. S. D. A.

Bks. Coll.=In the private collection of Mr. Nathan Banks.

Bks. Rev.=Recorded in Banks' Revision of the Ixodoidea.

Bks. 1902=Banks' account in Papers from the Hopkins Stanford Galapagos Expediton, 1898–1899, Proc. Wash. Acad. Sci. IV.

C. S. Bks. 1904=Recorded in C. S. Banks' paper on the Australian Tick in the Philippine Islands.

C. H. T. T. No. 69=Notes (by C. H. T. Townsend) from the Institute of Jamaica No. 69 (1893).

C. H. T. T. No. 71=*Ibid.* No. 71 (1893).

Fitch 1872=Recorded in the Fourteenth Report of the Noxious, Beneficial and Other Insects of the State of New York.

Garman Coll.=In the collection received from Prof. H. Garman.

Hadley 1909=Recorded in notes by P. B. Hadley, Science, N. S., vol. XXX, No. 774, pp. 605–606.

Hass. Coll=In the collection of Dr. A. Hassall.

Hook Notes 1909=Noted by the writer in an article in the JOURNAL OF ECONOMIC ENTOMOLOGY II, pp. 251–257.

H. and H. Bull.=Recorded in Bulletin No. 72 of the Bureau of Entomology, by Hunter and Hooker.

Hubbard 1894=Recorded in Insect Life, vol. VI, p. 306, by H. G. Hubbard.

Jo. Inst. Jam.=Recorded in the Journal of the Institute of Jamaica.

Lah. 1905=Recorded in Dr. F. Lahille's work entitled "Contribution a L'étude des Ixodidés de la République Argentine."

Leidy 1890=Recorded in the Proceedings of the Academy of Natural Sciences of Philadelphia, 1890.

Lewis 1908=Recorded in the Oklahoma Agricultural Experiment Station Bulletin 81, by L. L. Lewis.

March. and Salimb.=Recorded in the work of Drs. E. Marchoux and A. Salimbeni on "La Spirillose des Poules."

Mass. A. C. Coll.=In the collection of the Massachusetts Agricultural College.

Marx Coll.=In the Marx collection of the U. S. National Museum.

Mayo 1906=Recorded by Dr. N. S. Mayo in First. Ann. Rept. Agr'l Exp. Sta., Cuba, p. 44.

Mich. A. C. Coll.=In the collection of the Michigan Agricultural College.

M. C. A. Coll.=In the collection of the Museum of Comparative Zoölogy, Cambridge, Mass.

Morgan 1899=Recorded by Prof. H. A. Morgan in Bulletin No. 56 of the La. Agr'l Exp. Station.

N. 1897=In Dr. L. G. Neumann's Révision de la famille des Ixodidés II.

N. 1899=*Ibid.* III.

N. 1901=*Ibid.* IV.

N. 1902=In Neumann's Notes sur les Ixodidés I.
N. 1904=*Ibid.* II.
N. 1906=*Ibid.* IV.
Newell Coll.=In the collection of Prof. Wilmon Newell.
Niles 1900=Recorded by Dr. E. P. Niles in Bulletin No. 114 of the Va. Agr'l Exp. Station.
N. Y. S. M. Coll.=In the collection of the New York State Museum.
Osb. Coll.=In the collection of Prof. Herbert Osborn.
Pack. Amer. Nat. 1868=Recorded in American Naturalist, Vol. II.
Pack. Ann. Rep. 1869=Recorded in First Annual Report of the Peabody Academy of Science.
Pack. Amer. Nat. 1869=Recorded in American Naturalist, Vol. III.
Pack. Guide=Recorded in Packard's Guide to the Study of Insects.
S. and S. 1901=Recorded in Salmon and Stiles work on Cattle Ticks.
Say 1821=Recorded by Say in the Journ. Acad. Nat. Sci. of Phila. II.
Sim. Aub. and Noc. 1909=Recorded in article by Simond, Aubert and Noc in Comp. Rend. Soc. Biol., Paris, Vol. 66.
Stiles Coll.=In the collection of Dr. C. W. Stiles.
Washb. Coll.=In the collection received from Prof. F. L. Washburn.
W. and W. 1909=Recorded by Drs. W. B. Wherry and D. C. Wellman in Entomological News, Vol. XX, p. 376 (1909).

THE IDENTITY AND SYNONYMY OF SOME OF OUR SOFT SCALE-INSECTS

By J. G. Sanders, *Bureau of Entomology, Washington, D. C.*

So much confusion and misapprehension concerning the identity and classification of our soft scales has arisen during the past score of years that the average entomologist has been unable to determine the common species with any degree of certainty. This deplorable condition of our knowledge of this group of scale insects has been to a great extent the result of injudicious and hasty conclusions combined with scattered, meagre, unillustrated descriptions.

There has always been a tendency among entomologists, in dealing with insects belonging to the lower groups of Homoptera—Coccidæ, Aleyrodidæ, Aphididæ—to lay too much stress upon the particular host plant involved. The fact that a certain colony of insects, although apparently quite similar to another colony on its normal food plant, is found on a new food plant has influenced many entomologists to

describe as a new species the colony on the supposedly abnormal food plant.

Again, variations in size, color and vestiture have misled many to describe a mere variation as a new species or variety. Then, too, it was generally conceded by the early entomologists that the same species of such sedentary insects as coccids could not live on different food plants especially if the hosts belonged to different genera. A sentence in Fitch's original note-book expresses his views on this subject, when he describes the common oyster-shell scale as a new species because he found it on the dogwood (*Cornus stolonifera*), and adds: "Certainly there is the same ground for deeming the species of this genus, which occur upon plants of different genera, to be distinct species, that there is in the genus *Lecanium*." As the result of this idea, there are more than forty species and many more varieties of the genus *Lecanium* described in Fitch's note-book; but fortunately the majority of these descriptions never appeared in print. This idea, prevailing in the time of Linnæus, Geoffroy, Gmelin, Modeer, Fabricius, Burmeister, Schrank, Bouché and Boisduval, has resulted in the publication of a multitude of descriptions of supposedly new species, many of which have been subsequently reduced to synonymy. Unfortunately many of these names still remain as valid species in our catalogues; especially in the non-diaspine groups, and more especially those species of the genus *Lecanium*. Moreover, within the last decade or two, many species have been described and published here and there, from insufficient material, and without the careful study and comparison with other species which are nearly related, and with but little regard for the individual variations which are bound to appear in insects so absolutely dependent upon the kind and condition of their host plants as are the sedentary scale-insects. It is most unreasonable to expect to find a perfectly formed and fully developed Lecanium or Pulvinaria on a twig or stem of 1-16 inch diameter on a starved plant, when the normal form would appear only on the flat surface of a leaf or a large stem in vigorous growth. Prof. Robert Newstead in his Monograph of the British Coccidæ and more recently Dr. Paul Marchal, of Paris, have done some valuable work in the reduction of the synonyms of the early students of scale insects, and there is still much to be done.

The writer has been especially fortunate during the past five years to have access to the finest collection of Coccidæ in the world; a collection several times the value of any other in existence on account of the large percentage of type and cotype material; the national collection at Washington at the present time containing upwards of

850 types and cotypes, material of many other species, and thousands of slide preparations. The loan of the important Coccid collection of the late Wm. Maskell, of New Zealand, and the study of his types, have cleared up several doubtful classifications and confirmed several synonyms.

The following discussion of species and synonyms will necessarily be brief and general and will include only the more common species occurring in this country, with occasional references to their distribution in foreign countries. In a subsequent paper to be published by the U. S. Bureau of Entomology, the writer will review the genus *Lecanium* and discuss more fully the identity and synonymy of the species.

The writer retains the name *Lecanium* for some of those species which have been classified under *Eulecanium*, because it is impossible to eliminate *Lecanium* from our Coccid nomenclature. At least one species of the several included by Burmeister under his genus in the original description in Handbuch der Entomologie, II Band, p. 69 (1835), must be retained as the type. All the species which Burmeister really placed under his genus have been removed to other genera except *persicæ*, which should be considered the type. *Eulecanium* becomes a synonym of *Lecanium*.

This paper is submitted for publication with the permission of Dr. L. O. Howard, Chief of Bureau.

The Greenhouse Orthezia

Orthezia insignis Dougl.

Plate 19, Fig. 10

Orthezia insignis Dougl., Jn. Quekett Micr. Club, p. 169 (1887).
Orthezia nacrea Buckton, Ind. Mus. Notes, III, 3, p. 103 (1894).

In tropical regions this scale insect is generally known as the Lantana bug, because of its predilection for that plant. It occurs only in greenhouses in temperate regions, where it attacks principally Lantana, Coleus, Citrus spp., Verbena, Chrysanthemum, Ipomoea, Capsicum, etc., and is a difficult pest to eradicate.

The adult female with her fully developed, fluted white ovisac and marginal fringe of white waxy laminæ is a beautiful insect. This species is readily distinguished from all other species of the genus by the large area of the dorsum which is without a waxy covering, revealing the dark green body color.

All the species of this genus bear these white waxy laminæ in characteristic arrangement.

The Pit-Making Oak Scale

Asterolecanium variolosum (Ratz.)

Plate 19, Fig. 11

Coccus variolosus Ratz., Tharander Jahrbuch, p. 187 (1870).
Asterolecanium quercicola Sign., An. Soc. Ent. Fr., 4, X, p. 279 (1870).
Lecanium quercicola Altum, Forstzoölogie, III, pt. 2, p. 365 (1882).
Asterodiaspis quercicola Rübs., Berl. Ent. Zeit., XXXIX, p. 200 (1894).
Coccus quercicola Eckst., Forstzoölogie, p. 556 (1897).
Asterolecanium variolosum Ckll., Pr. Ac. N. Sci. Ph., p. 269 (1899).

This species is the only one of its genus which is found outside of greenhouses in the northern section of this country. It is a native of the Palearctic region and lives only on various species of oaks.

There have been many references in literature to this scale under the name *A. quercicola* Bouché, but Bouché's original description undoubtedly refers to what is known as *Aspidiotus zonatus* Frauenf. Ratzeburg's description of *variolosum* is good and is illustrated by fair figures.

Reports are at hand of its occurrence in Massachusetts, Connecticut, New York, Pennsylvania, Ohio, Michigan, Maryland, New Jersey, Virginia, North Carolina, District of Columbia and Ontario.

This scale is nearly circular in outline and somewhat convex, delicately ridged transversely, and yellowish-green to bronze green in color when alive. After the death of the female the body shrinks, and becomes reddish brown, the color showing through the anterior part of the test. Diameter about 2 mm. The adult female lacks legs and antennæ and exhibits few microscopic characters other than the marginal row of figure 8 pores.

The Long-Tailed Mealy Bug

Pseudococcus adonidum (Linn.).

Plate 19, Fig. 1

Coccus adonidum Linn., Syst. Nat., Ed. XII, p. 140 (1767).
Pseudococcus adonidum Westw., Mod. Class. Ins., I, Synop., p. 118 (1839).
Coccus liliacearum Bouché, Stett. Ent. Zeit., p. 300 (1844).
Coccus tuliparum Bouché, Stett. Ent. Zeit., p. 301 (1844).
Coccus zamiæ Lucas, Bul. Soc. Ent. Fr., 3, V, p. CVII (1855).
Dactylopius longispinus Targ., Catalogue, p. 32 (1869).
Dactylopius hoyæ Sign., An. Soc. Ent. Fr., 5, V, p. 317 (1875).
Dactylopius pteridis Sign., An. Soc. Ent. Fr., 5, V, p. 321 (1875).
Dactylopius longifilis Comst., Rep. U. S. Dep. Agr., 1880, p. 344 (1881).

The general appearance of this soft, mealy, segmented scale-insect is well shown in the accompanying plate. There are but few species

of this genus exhibiting the very long caudal waxy filaments, and one is pretty safe in identifying as this species the common longtailed mealy-bugs of our greenhouses. It occurs on many plants but its range of hosts is hardly as great as that of the short-tailed species, *Pseudococcus citri*.

There are seventeen white waxy marginal filaments of various lengths on each side of the body which is covered lightly with powdery wax. The four posterior filaments are sometimes longer than the body. The segments are quite distinct. On each side of the anal lobes are two microscopic sharp spines surrounded by a circle of closely-grouped pores, easily distinguishable from the scattered arrangement in *citri*.

There is no reason why Linnæus' name of this insect should be discarded in favor of *longispinus* Targ., when we have such a good description of the insect in Systema Naturæ, Ed. XII, even though the name had been used previously in Fauna. Suecica and omitted from Ed. X.

Bouché's species *liliacearum* and *tuliparum* are undoubtedly synonyms differing according to description only in size, and both occur on plants of the same group and under similar conditions. Bouché says they are near *adonidum*. *Coccus zamiæ* Lucas was described from *Zamia australis* and *Z. spiralis*, plants originally from Australia, but growing for some time in the Paris Botanic Gardens where *adonidum* was abundant. The writer has seen *Zamia* sp. literally covered beneath with *Pseud. adonidum* and *Saissetia hemisphærica* (Targ.).

Maskell in 1895 [Ann. Mag. N. H., 6, XVI, p. 133 (1895)] considered *Dact. liliacearum*, *D. tuliparum* and *D. hoyæ* to be synonyms of *D. adonidum* (Linn.).

The Short-Tailed Mealy Bug

Pseudococcus citri (Risso)

Plate 19, Fig. 2

Dorthesia citri Risso, Essai, Hist. Nat. des Oranges (1813).
Coccus citri Bdv., Ent. Hort., p. 348 (1867).
Dactylopius citri Sign., An. Soc. Ent. Fr. (5), v. p. 312 (1875).
Lecanium phyllococcus Ashm., Can. Ent., XI, p. 160 (1879).
Dactylopius brevispinus Targ., Annali di Agr., p. 137 (1881).
Dactylopius destructor Comst., Rep. U. S. Dep. Agr., 1880, p. 342 (1881).
Pseudococcus citri Fernald, Cat. of Coccidæ, p. 99 (1903).

This very common mealy-bug infests so many species of plants that it would be much easier to list those not affected, so omnivorous is it

in habit. The accompanying photograph will convey an idea of its superficial appearance more accurately than description. When many specimens are massed on a plant the filaments are disarranged and intermingled so that the characteristic appearance is somewhat lacking. The mid-dorsal longitudinal brownish band is quite characteristic of this species. The microscopical characters of the anal lobes readily distinguish it from *adonidum*, by the two spines and scattered pores as contrasted with the closely grouped pores in the latter species.

The ovisacs of *citri* as well as *adonidum* are normally of a flattened cylindrical form constructed of loose waxy threads, but when the insects are crowded the ovisacs are irregularly massed.

This scale has been a pest in citrus groves in southern Europe for many years, and now its damage is assuming alarming proportions in the lemon groves of southern California. Every greenhouse propagator knows this insect as a pernicious and aggravating pest.

The Cottony Maple-Scale

Pulvinaria vitis (Linn.)

Coccus vitis Linn., Syst. Nat., Ed. X, 1, p. 456 (1758).
Coccus innumerabilis Rathv., Penn. Farm Journ., p. 256 (1854).
Lecanium pyri Fitch (in part), Tr. N. Y. Agr. Soc., p. 809 (1854).
Lecanium macluræ Fitch, Country Gentleman, V, p. 38 (1855).
Lecanium acericorticis Fitch, 6th Rep. Ins. N. Y., p. 775 (1859).
Lecanium acerella Rathv., Lancaster Farmer, p. 101 (1876).
Pulvinaria innumerabilis var. *occidentalis* Ckll., The Entom., XXX, p. 13 (1897).
Pulvinaria innumerabilis var. *tiliæ* King & Ckll., Psyche, VIII, p. 286 (1898).
Pulvinaria hunteri King, Can. Ent., XXXIII, p. 144 (1901).
Pulvinaria simplex King, Mitth. Schw. Ent. Ges. (10), X, p. 475 (1903).

This is a well known scale in the United States, which in Europe is popularly known as the vine cottony scale. It is one of the most conspicuous scales of this country when the ovisac of the female is fully developed, and is considered a variable pest from year to year. The periodicity of its appearance in dangerous numbers is due directly to the rise and fall in numbers of its parasites and natural enemies.

This scale is discussed and figured in Bulletin No. 22, n. s., and in Circular No. 64, U. S. Bureau of Entomology, under the name of ***Pulvinaria innumerabilis*** Rathv., but a careful study of our insect in this country reveals absolutely no differences from the common European species, *P. vitis* (Linn.). Fitch's types have also been compared, resulting in the above synonymy. A study of several supposed species and varieties of Pulvinaria, consisting of transplantings

of young crawling larvæ from various hosts in different parts of the country to other hosts, and the subsequent changes in size and outward appearance, has convinced the writer that the host plant has an unexpectedly potent influence in the development of the insect. During the great outbreak of this scale in Chicago and vicinity in 1906, the writer brought from Chicago twigs of maple and box-elder with hundreds of the egg-sacs filled with eggs, and tied the twigs to a number of kinds of trees. In due time the eggs hatched and many of the larvæ set and molted and developed very satisfactorily on their new food plants, while on some trees a large percentage failed to develop.

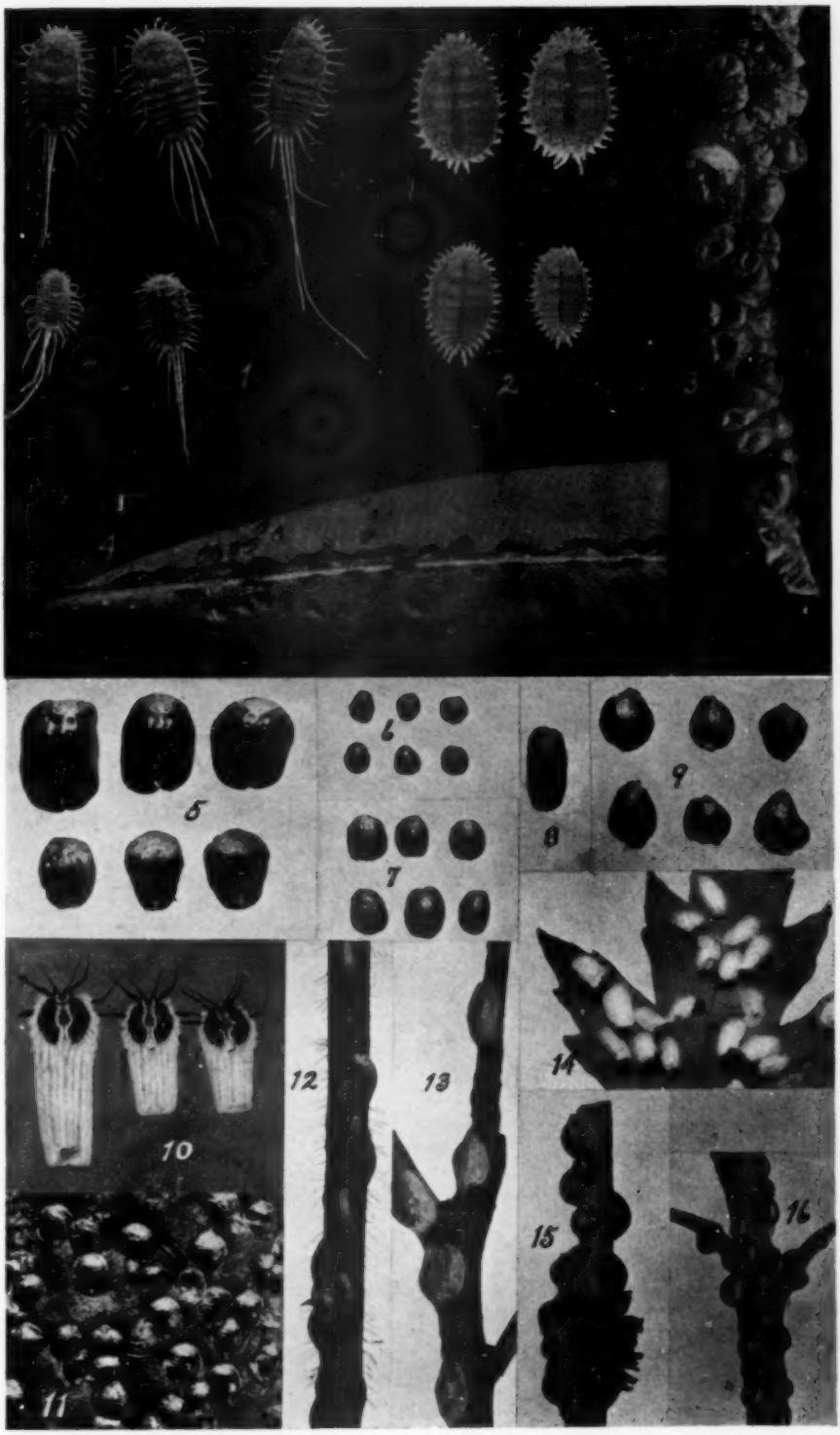
The following spring and early summer brought forth a revelation in the various sizes, colorations and markings of the rapidly developing females on the various food plants. On young rapidly growing sycamore (*Platanus occidentalis*) and linden (*Tilia americana*) which were well cared for in large pots, the adult females just before the formation of the ovisac averaged 8 mm. in length and 6 mm. in breadth, and were mottled and marked with unusual brilliancy. The smallest females obtained in this experiment were grown on boxwood (*Buxus sempervirens*) and averaged but 2.75 mm., while but four specimens reached maturity. Transplantings were successful on apple, pear, quince, mulberry. grape, osage-orange, poison ivy (*Rhus toxicondendron*), *Ampelopsis tricuspidata,* plum, boxwood, spiræa, maple, box-elder, *Viburnum prunifolium, Quercus coccinea, Ptelea*

EXPLANATION OF PLATE 19

1. *Pseudococcus adonidum* Linn.
2. *Pseudococcus citri* Risso.
3. *Toumeyella liriodendri* Gmel.
4. *Coccus hesperidum* Linn. on Oleander leaf.
5. *Lecanium caryæ* Fitch.
6. *Lecanium nigrofasciatum* Pergande.
7. *Lecanium corni* Bouché.
8. *Lecanium persicæ* (Fab).
9. *Lecanium quercifex* Fitch.

Nos. 5–9 are natural size and photographed simultaneously.

10. *Orthezia insignis* Dougl.
11. *Asterolecanium variolosum* (Ratz.) on Oak.
12. *Coccus elongatus* (Sign.) on Mimosa.
13. *Neolecanium cornuparvum* (Thro) on Magnolia twig.
14. *Pulvinaria acericola* Walsh & Riley.
15. *Lecanium corni* Bouché on Honeysuckle.
16. *Saissetia hemisphærica* (Targ.) on *Persea gratissima.*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trifoliata, honey locust, American elm and hackberry (*Celtis occidentalis*). The superficial appearance of the adult females on different host plants varied remarkably as did also the size and bulk of the ovisacs.

Further study may reveal other synonyms of this species in the United States and Europe. Newstead, in his Monograph of British Coccidæ, has reduced many species names of the early authors to synonymy with *P. vitis*.

The Cottony Maple-Leaf Scale

Pulvinaria acericola (Walsh & Riley)

Plate 19, Fig. 14

Lecanium acericola W. & R., Amer. Ent., I, p. 14 (1868).
Pulvinaria acericola Ckll., Check List, p. 329 (1896).

This species in the adult stage is usually found only on the leaves of maple, while *P. vitis* occurs invariably on the branches or twigs of its host. This habit means that the latter species, which develops in the younger stages on the leaves and migrates to the twigs before the falling of the leaves, changes location but once, while *P. acericola* migrates twice during its life history, *i. e.*, from leaf to twig in autumn, and back to the new leaves in the following spring.

The females of *acericola* are very distinct from *vitis* in the more adult stages, having small patches of cottony wax on the dorsum, and developing a very long, fluted ovisac, which is narrower than that of *vitis*. The microscopic characters are also distinctly different. A complete illustrated discussion of the life history and habits of this scale-insect appeared in Bulletin 22, n. s., U. S. Bureau of Entomology in 1900.

The Tessellated Scale

Eucalymnatus tessellatus (Sign.)

Plate 20, Fig. 1

Lecanium tessellatum Sign., An. Soc. Ent. Fr., 5, III, p. 401 (1873).
Lecanium perforatum Newst., Ent. Mon. Mag., XXX, p. 233 (1894).
Lecanium tessellatum var. *perforatum* Ckll., Psyche, VIII, p. 90 (1897).
Eucalymnatus tessellatus Ckll., Ann. Mag. N. H., 7, IX, p. 453 (1902).
Lecanium subtessellatum Green, Cocc. of Ceylon, pt. III, p. 206 (1904).

This species infests a wide range of food plants and is almost unmistakable in appearance. It is exceedingly flat, usually asymmetrical, brown to dark brown, and reveals its remarkable tessellation to the unaided eye. Under the microscope the beautiful pattern is disclosed

and the derm appears as if composed of nicely fitted plates riveted together, so remarkable is the arrangement of small pores around the margins of the plates. The entire derm is full of pores of various kinds.

Newstead described a supposedly new species, called *perforatum* on account of a series of ten rather large pores in some of the posterior submarginal plates, which Signoret failed to mention in his description of *tessellatus,* a character which might easily have been omitted among the other more remarkable characters of this species. There are specimens of this species in the Fitch Collection at Washington from Signoret, and these all show the "perforations." The writer has examined hundreds of specimens of this species and all exhibit this same character.

Green in 1904 described from Ceylon, as *subtessellatum,* what he considered a new species, because the specimens he had at hand were apparently immature and lacked the strong tessellation in the middorsal region. Later Mr. Green has recalled the species after examining a larger series of these scales, and considers the above synonymy as correct.

The Soft Brown Scale

Coccus hesperidum Linn.

Plate 19, Fig. 4

Coccus hesperidum Linn., Syst. Nat. Ed. X, I, p. 455 (1758).
Chermes hesperidum Geoff., Abr. Ins., I, p. 505 (1762).
Calypticus hesperidum Costa, Faun. Reg. Nap., Cocc., p. 8 (1835).
Calypticus lævis Costa, Faun. Reg. Nap., Cocc., p. 8 (1835).
Calymmatus hesperidum Costa, Nuov. Osserv., p. 22 (1835).
Coccus patelliformis Curt., Gard. Chron., p. 517 (1843).
Chermes lauri Bdv., Ent. Hort., p. 340 (1867).
Lecanium platycerii Pack., Rep. Mass. Bd. Agr., p. 260 (1870).
Lecanium angustatum Sign., An. Soc. Ent. Fr., 5, III, p 398 (1873).
Lecanium maculatum Sign., An. Soc. Ent. Fr., 5, III, p. 400 (1873).
Lecanium alienum Dougl., Ent. Mon. Mag., XXIII, p. 77 (1886).
Lecanium depressum var. *simulans* Dougl., Ent. Mon. Mag., XXIV, p. 28 (1887).
Lecanium minimum Newst., Ent. Mon. Mag., XXVII, p. 141 (1892).
Lecanium assimile var. *amaryllidis* Ckll., Tr. Am. Ent. Soc., XX, p. 53 (1893).
Lecanium terminaliæ Ckll., Jn. Inst. Jam., I, p. 254 (1893).
Lecanium nanum Ckll., Psyche, VII, Suppl., 1, p. 19 (1896).
Lecanium flaveolum Ckll., Psyche, VIII, pp. 52, 53 (1897).
Lecanium minimum var. *pinicola* Mask., N. Z. Trans., XXIX, p. 310 (1897).
Lecanium ventrale Ehrh., Can. Ent., XXX, p. 245 (1898).
Lecanium (*Calymnatus*) *hesperidum pacificum* Kuw., Jn. N. Y. Ent. Soc., X, p. 30 (1902).
Lecanium signiferum Green, Cocc. of Ceylon, pt. III, p. 197 (1904).

The fact that this scale has been redescribed so frequently under different names in various countries is alone proof of its exceptional importance to horticulturists and gardeners and of its widespread occurrence and great range of food plants. It is improbable that any other species of the soft scales is known to infest so many species of plants in widely divergent genera. In the writings of the very early European entomologists relating to scale insects, this species was always the preëminent one, from which we may assume that it was then the most important economic species of the region. At the present time it is a pest in those regions where it is permitted to multiply through the carelessness of man, or on account of favorable climate, or both combined.

The following description of the adult female by E. E. Green (Coccidæ of Ceylon, p. 188, 1904) is quite complete and furnishes an idea of some of the variations in markings, etc., which are found in this species.—"Adult female bright yellow or greenish-yellow, minutely specked with red-brown, the specks sometimes agglomerated into transverse bars, especially on the median abdominal region: in other parts tending to form dotted lines radiating from center to margin. In older examples the ground color may be ochreous or pale fulvous; and the maculation may form a broad median fascia. Under surface of older examples with a deep purple-brown or red patch covering the median abdominal area, becoming concave and forming a shelter for the young larvæ. Dried specimens straw-colored and much wrinkled. Form oblong-oval, often very irregular in outline; narrowest in front; more or less concave above according to age. In some individuals, generally on those protected by some shelter, I have noticed a double median longitudinal series of raised glassy points; but they appear to be very brittle and easily lost." Length, 2.5—5 mm.; breadth, 1.5—3 mm.

In view of the great variation in size, color and markings, there are plausible excuses for the frequent redescriptions of this cosmopolitan species under new names; but entomologists should take into account a certain probable variability in any insects they describe as new or otherwise.

Some of the above synonymy is here proposed for the first time, but several names have been reduced by Newstead, Green and Fernald. For the reduction of *angustatum*, *maculatum*, *terminaliæ*, *nanum*, *flaveolum*, *minimum*, var. *pinicola*, *ventrale*, *hesperidum* var. *pacificum*, and *signiferum*, the writer is responsible. These reductions are made only after very careful morphologic study with a high power microscope of typical material, and after biological study of the forms

so far as possible on many food plants. Resulting variations secured by transference to different food plants, were fully as remarkable as observed in the case of *Pulvinaria vitis* (L.).

The Long Soft Scale

Coccus elongatus (Sign.)

Plate 19, Fig. 12

Lecanium elongatum Sign., An. Soc. Ent. Fr., 5, III, p. 404 (1873).
Lecanium longulum Dougl., Ent. Mon. Mag., XXIV, p. 97 (1887).
Lecanium chirimoliæ Mask., N. Z. Trans., XXII, p. 137 (1889).
Lecanium ficus Mask., Ent. Mon. Mag., XXXIII, p. 243 (1897).
Lecanium frontale Green, Cocc. Ceylon, pt. III, p. 192 (1904).

This species is quite similar in general appearance to *C. hesperidum* with its color variations, but is elongate elliptical to varying degrees, depending upon the exigency of location; and is ordinarily rather more convex than the latter species. The eight-segmented antennæ will identify it easily from those of *hesperidum* with but seven. The latter species has but four fringe spines arranged in a transverse line about midway across the anal plates, while there are eight in *elongatus*.

The specific name *elongatum* Sign., takes precedence over *longulum* Dougl., since an examination of specimens from Signoret in the Fitch collection verifies this synonymy. *L. chirimoliæ* and *L. ficus* of Maskell are also synonyms. *L. frontale* Green has been a puzzle for some time because the writer could find no morphologic characters to differentiate it from *elongatus*, except its more narrow form. But the discovery of *elongatus* on leaves of Anthurium, Calophyllum and Croton exhibiting all the forms connecting the typical *elongatus* and typical *frontale* has cleared the situation. On these plants the young scale has settled close to the high midribs or larger veins and its development has been more linear than usual, resulting in the greater length of body anterior to the antennæ and posterior to the anal plates. In all microscopic characters—derm pores, antennæ, legs,

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EXPLANATION OF PLATE 20

Photomicrographs showing characteristic derm pores; all at same magnification.

1. *Eucalymnatus tessellatus* (Sign.).
2. *Saissetia oleæ* (Bern.).
3. *Saissetia nigra* (Nietn.).
4. *Saissetia hemisphærica* (Targ.).
5. *Toumeyella liriodendri* (Gmel.).
6. *Neolecanium cornuparvum* (Thro).

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marginal and spiracular spines, anal plates and spines—the similarity is evident.

The Hemispherical Scale

Saissetia hemisphærica (Targ.)

Plate 19, Fig. 16; Plate 20, Fig. 4

Lecanium hemisphæricum Targ., Studii sul. Cocc., pp. 26, 27, etc. (1867).
Chermes anthurii Bdv., Ent. Hort., p. 328 (1867).
Chermes filicum Bdv., Ent. Hort., p. 335 (1867).
Chermes hibernaculorum Bdv., Ent. Hort., p. 337 (1867).
Lecanium coffeæ Sign., Ann. Soc. Ent. Fr., 5, III, p. 435 (1873).
Lecanium beaumontiæ Dougl., Ent. Mon. Mag., XXIV, p. 95 (1887).
Lecanium clypeatum Dougl., Ent. Mon. Mag., XXV, p. 58 (1888).
Lecanium hemisphæricum var. *hibernaculorum* Ckll., Bul. Bot. Dep. Jamaica, p. 71 (1894).
Lecanium hemisphæricum var. *filicum* Green, Ent. Mon. Mag., XXXIII, pp. 70, 77 (1897).
Lecanium (*Saissetia*) *coffeæ* var. *clypeatum* Ckll. & Parr., The Industrialist, p. 164 (1899).
Saissetia hemisphærica Ckll., The Ent. Student, II, p. 32 (1901).
Coccus coffeæ Kirkaldy, Fauna Haw., III, pt. 2, p. 105 (1902).

The common name of this scale is descriptive of its form, although it is not exactly hemispherical but a little elongate and frequently higher than broad. The shape, smooth surface, brown color, and the minute pale dots of the skin which are easily seen with the aid of a hand-lens, will distinguish this common species. As in all species of this genus, the derm is filled with microscopic pores.

A number of species and varieties have been described by early authors which are now known to be synonyms. A form known as *filicum*, occurring on ferns has been held to be a different species, but a long study of this form and its transference from various hosts to ferns and vice versa indicates that not even varietal rank should be considered.

Mr. W. C. Thro, in Bul. 209, Cornell Univ. Agr. Exp. Sta., describes *filicum* as varying from *hemisphærica* in the number of "fringe spines" on the anal plates, but a careful examination of Mr. Thro's slides reveals the ordinary number of spines, although small, in his specimens which were immature.

This species is perhaps more widely (if possible) distributed throughout the world than *S. oleæ*, and infests a wider range of plant life. It occurs only in greenhouses in temperate regions.

The Olive Scale

Saissetia oleæ (Bern.)

Plate 20, Fig. 2

Chermes oleæ Bern., Mem. d'Hist. Nat. Ac. Marseille, p. 108 (1782).
Coccus olea Oliv., Ency. Meth., VI, p. 95 (1791).
Coccus palmæ Haw., Tr. Ent. Soc. Lond., p. 307 (1812).
Coccus testudo Curt., Gard. Chron., p. 444 (1843).
Coccus cycadis Bdv., Ent. Hort., p. 323 (1867).
Lecanium cassiniæ Mask., N. Z. Trans., XXIII, p. 15 (1890).
Lecanium oleæ var. *testudo* Ckll., Check List, p. 331 (1896).
Lecanium oleæ var. *mirandum* Ckll. & Parr., Biol. Centr. Am., II, pt. 2, p. 12 (1899).
Coccus oleæ Kirkaldy, Fauna Haw., III, pt. 2, p. 106 (1902).

In view of the fact that this species has been described and figured so frequently in various reports, it seems hardly necessary to describe it again in full. The popular name "black scale" has been applied to this species, but rather incorrectly, since it is usually very dark brown; the above name should be applied properly to *Saissetia nigra*, which in the adult female stage usually becomes truly black.

A thorough study of this species warrants the above synonymy, part of which Professor Newstead proposes and the remainder is vouched for by the writer after examining typical material. Maskell, in his notes, doubts the validity of his species, *cassiniæ*, and an examination of his types sinks the name.

This species is readily recognized by its thick convex, dark-brown scale dotted with minute flakes of wax, and bearing two more or less prominent transverse ridges and a median longitudinal ridge in the form of a letter H. The young female of the hemispherical scale sometimes exhibits this character to a slight degree, but it vanishes toward maturity.

The olive scale infests a wide range of food plants and is found in nearly every greenhouse where tropical plants are grown, and is a pest in the warmer regions of the United States.

The Black Scale

Saissetia nigra (Nietn.)

Plate 20, Fig. 3

Lecanium nigrum Nietn., "Enemies of Coffee-tree," p. 9 (1861).
Lecanium depressum Targ., Studii sul. Cocc., p. 29 (1867).
Lecanium begoniæ Dougl., Ent. Mon. Mag., XXVIII, p. 209 (1892).
Lecanium nigrum var. *depressum* Ckll., Check List, p. 332 (1896).
Saissetia depressa King, Psyche, IX, p. 296 (1902).

Saissetia nigra King, Psyche, IX, p. 296 (1902).
Saissetia nigrella King, Psyche, IX, p. 296 (1902).
Coccus nigrum Kirkaldy, Fauna Haw., III, pt. 2, p. 106 (1902).

This species is of less importance in the United States than either of the other species of this genus mentioned here. Its distribution has been effected to all quarters of the globe, occurring on many different plants. In some of the West Indian Islands it is a very important cotton pest and difficult to control.

It is included in this paper principally to record its synonyms which have been described from various regions and until recently held as distinct species.

The European Peach Scale

Lecanium persicæ (Fab.)

Plate 19, Fig. 8

Chermes persicæ Fab., Gen. Ins. Mant., p. 304 (1776).
Chermes clematitis Gmel., Syst. Nat., Ed. XIII, p. 2220 (1789).
Lecanium cymbiformis Targ., Catalog. Coccidarum, p. 37 (1868).
Lecanium berberidis Sign. (non. Schr.[1]) Essais, p. 233 (1873).
Lecanium genistæ Sign., Essais, pp. 235, 484 (1873).
Lecanium persicæ Sign., Essais, p. 237 (1873).
Lecanium rosarum Sign., Essais, p. 257 (1873), (non Sn. v. Voll., 1862).
Lecanium berberidis Mask., N. Z. Trans., XXIX, p. 311 (1897).
Lecanium subaustrale Ckll., The Entom., XXXI, p. 131 (1898).
Lecanium magnoliarum Ckll., Ent. News, IX, p. 146 (1898).
Lecanium magnoliarum var. *hortensiæ* Ckll., Psyche, X, p. 19 (1903).

The genuine *L. persicae* is a large chestnut brown species 5—7 mm. long with 8-segmented antennae as described by Signoret. It is much less convex than *L. corni* and is sometimes rather flattened toward the margins. The 24 to 28 large conspicuous pores in a submarginal row will also aid in identifying this species.

It apparently has been recorded in the United States only from California under the name of *Lec. magnoliarum.*

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[1]*Coccus berberidis* Schrank, Fauna Boica, II, Abt. 1 (1801) is not a Lecanium at all, but the description surely refers to *Mytilaspis pomorum.* "Schinkenmuschelförmig, dunkel rothbraun, weislicht gerandet, am schmälern Ende rostbraun." Freely translated is—Oystershell-shape, dark red brown, pale-margined, rust-brown at the small end. Schrank also refers to the impure white eggs occurring beneath the dead body of the female in April, which is too early for such a record of a Lecanium in a temperate region.

The Frosted Scale

Lecanium pruinosum Coquillett.

Lecanium pruinosum Coq., Ins. Life, III, p. 382 (1891).
Lecanium robiniæ Towns., Bull. 7, N. Mex. Exp. Sta., p. 11 (1892).
Lecanium robiniarum Ckll. (non Dougl.) Can. Ent., XXVII, p. 257 (1895).
Eulecanium robiniæ var. *subsimile* Ckll., The Entom., XXXV, p. 178 (1902).

This species, which has been of some economic importance in California, seems to be a native of the highlands of Mexico, whence it has been introduced to the fruit districts of the above State. The synonymic variety *subsimile*, which occurs on ash or Rhus (?) in Mexico, points to this region as the probable home of *L. pruinosum*. The specific name is descriptive of this species when it is covered with fine powdery wax, but this character is not always evident in some localities where it occurs. Its general appearance is like a very large *L. corni*, very convex, dark reddish brown, variously pitted and grooved; the 7-jointed antennæ and the legs and other characters are quite similar to *corni*, but the derm pores furnish the most evident character for the species, as will be seen by reference to the photomicrograph of the derm. The pores are small, clearly defined, and regularly arranged, but they do not show a tendency to arrange themselves in broken rows perpendicular to the margin as in *L. corni*.

This species occurs in California on the apricot, peach, plum, prune, pear, apple, ash, locust, English walnut, grape, rose, etc. In New Mexico, Arizona and Mexico there may be many other hosts.

The Hickory Lecanium

Lecanium caryæ (Fitch)

Plate 19, Fig. 5

Lecanium caryæ Fitch, 3d Rep. Ins. N. Y., p. 125 (1856).
Lecanium cockerelli Hunter, Kan. Univ. Quar., VIII, p. 70 (1899).
Eulecanium caryæ King, Can. Ent., XXXIV, p. 160 (1902).

Contrary to published reports, Fitch's types of this species are in the national collection at Washington in good condition, so that we know the species accurately. There is little possibility that any one should confuse it with any of our other Lecaniums on account of its enormous size; length, 10–13 mm.; breadth, 7–9 mm., and height, 3–5 mm. The buff or yellowish-brown color of the developing female changes after oviposition to a beautiful deep reddish brown dusted with waxy powder.

This species is a victim of several species of minute hymenopterous

parasites, which usually distort its normal shape and size to a remarkable degree. Many specimens collected in Ohio by the writer from elm, hickory, willow, peach, etc., are so distorted that they would not be recognizable if met with singly. A microscopic examination will surely determine the species, however, if the unusually numerous, large marginal spines are noted, along with the ordinary 6–7 segmented small antennæ.

That *Lecanium cockerelli* Hunter is but a parasitized and distorted form of this species, is the conclusion reached by the writer after collecting and examining many specimens along with Professor Hunter's types. The fact, as reported in the original description, that the tree bearing the types of this form was badly infested, and the following year was almost free from this scale, would suggest almost complete parasitism.

The European Fruit Lecanium

Lecanium corni (Bouché)

Plate 19, Figs. 7, 15

Lecanium corni Bouché, Stett. Ent. Zeit., V, p. 298 (1844).
Lecanium tiliæ Fitch (non Linn.), 4th Rep. Reg. Univ. N. Y., p. 69 (1851).
Lecanium pyri Fitch (in part), Tr. N. Y. St. Agr. Soc., p. 809 (1854).
Lecanium cerasifex Fitch, 3d Rep. Ins. N. Y., p. 50 (1859).
Lecanium ribis Fitch, 3d Rep. Ins. N. Y., p. 109 (1859).
Lecanium cynosbati Fitch, 3d Rep. Ins. N. Y., p. 118 (1859).
Lecanium juglandifex Fitch, 3d Rep. Ins. N. Y., p. 145 (1859).
Lecanium corylifex Fitch, 3d Rep. Ins. N. Y., p. 155 (1859).
Lecanium fitchii Sign., Ann. Soc. Ent. Fr. (5), III, p. 404 (1873).
Lecanium tarsale Sign., Ann. Soc. Ent. Fr. (5), III, p. 430 (1873).
Lecanium armeniacum Craw, Rep. Cal. Bd. Hort., p. 12 (1891).
Lecanium robiniæ Towns., Bull. 7, N. Mex. Exp. Sta., p. 11 (1892).
Lecanium caryæ var. *canadense* Ckll., Can. Ent., XXVII, p. 253 (1895).
Lecanium lintneri Ckll. & Benn., Am. Nat., XXIX, p. 381 (1895).
Lecanium crawii Ehrh., Can. Ent., XXX, p. 245 (1898).
Lecanium caryarum Ckll., Can. Ent., XXX, p. 293 (1898).
Lecanium maclurarum Ckll., Can. Ent., XXX, p. 294 (1898).
Lecanium kingii Ckll., Ann. Mag. N. H. (7), II, p. 322 (1898).
Lecanium kansasense Hunter, Kan. Univ. Quar., VIII, p. 69 (1899).
Lecanium aurantiacum Hunter, Kan. Univ. Quar., IX, p. 107 (1900).
Lecanium websteri King, Can. Ent., XXXIII, p. 106 (1901).
Eulecanium guignardi King, Can. Ent., XXXIII, p. 334 (1901).
Eulecanium rosæ King, Can. Ent., XXXIII, p. 336 (1901).
Lecanium adenostomæ Kuwana, Pr. Cal. Ac. Sci. (3), II, p. 402 (1901).
Eulecanium fraxini King, Can. Ent., XXXIV, p. 158 (1902).
Lecanium obtusum Thro, Bull. 209, Corn Univ. Expt. Sta., p. 212 (1903).
Eulecanium folsomi King, Can. Ent., XXXV, p. 193 (1903).

Besides the above long list of American synonyms, Dr. P. Marchal in his excellent treatise on European scale insects has designated the following European species as synonyms, viz., *vini* Bouché, 1844; *rosarum* Snell v. Voll., 1862; *mori* Sign., 1873; *coryli* Sign., 1873; *rugosum* Sign., 1873; *wistariæ* Sign., 1873; *sarothamni* Dougl., 1891; *assimile* Newst., 1892; *rehi* King, 1901; *persicæ* Newst., 1903; *persicæ* var. *coryli* Newst., 1903; *persicæ* var. *sarothamni* Newst., 1903.

What Muse guided the minds of entomologists while describing this species under its various aliases, the writer scarcely dares conjecture. A certain spell of belief or unbelief, whichever you may choose, must have worked its charm at the psychological moment causing each new lot of specimens from a new locality or food-plant to appear as specifically distinct.

We have also, as bases for new species, exceedingly careful measurements to the thousandth part of a millimeter, of the segments of the antennæ which may be 6-segmented on one side and 7-segmented on the other side of the same scale, or in the case of a parasitized specimen may be 8-segmented or only 5-segmented.

Then again we have what may be designated as "honor" species, since more valid reasons for their existence seem to be lacking, such as *fitchii, lintneri, websteri,* etc. It is well that the integrity and honor of those bearing these names will not be shattered by the downfall of the species dedicated to them.

For several years the writer has carefully added species after species to the synonymy of this exceedingly common Lecanium, only after examining the types or cotypes. The writer has studied the types of all the above names with the exception of four, and in those cases similar topotypic material was seen. Sufficient breeding work in transferring species from tree to tree, with their attendant changes in appearance, was carried out to convince the writer that his observations on the behavior of the cottony maple scale were almost duplicated in this species. Remarkable changes are wrought in the individual scales when transferred to a new host plant.

The synonymy of these species with *L. cerasifex* Fitch has been in hand for some time, but only this year, by means of material from Europe and with the aid of Dr. Paul Marchal's excellent studies on European Lecaniums,[1] has the writer included this entire synonymy under *L. corni* Bouché.

This common species which occurs on so many of our economic and

[1]Notes sur les Cochenilles de l'Europe, Ann. Soc. Ent. France, Vol. LXXVII, pp. 223-309 (1908). Plate and text figures.

wild trees and shrubs, is quite convex in form with irregular, varying rugosities and pits in the hard brown derm of the adult or dead female. Various fuscous transverse and longitudinal markings are evident on the young adult female scale before oviposition in early summer. These markings rapidly disappear at her death and darker brown suffuses the derm, leaving sometimes a trace of fuscous on the dorsum.

The cleared derm appears brownish, antennæ 6 or 7-segmented, usually the latter; legs well developed, ordinary; anal plates heavily chitinized, together forming nearly a square; 6 large and 2 small hairs, on the anal ring; marginal spines rather short and stout 18–24 *mmm.* in length; spiracular spines variable, rather slender, the shorters ones 30–40 *mmm.* and the middle one 50–60 *mmm.* in length. The cleared derm shows extra heavy chitinization of the regions along the anterior margin extending inward toward the antennæ, and also of the posterior lobes near the cleft. The characteristic general arrangement of the many derm pores in very irregular, broken and interrupted radiating rows, is especially noticeable near the margin. In some specimens this character is not so marked.

This species occurs widely in North America on a very great range of mostly deciduous trees and shrubs. In a few instances it has become of economic importance, but not for long on account of its control by natural enemies and parasites. This species determined under various names threatened the plum orchards of New York state a few years ago, and more recently has been occasionally reported from various states of the middle-west as a pest on elm, mulberry, osage-orange and linden.

The range of this species includes practically every state in the Union, and its host-plant list is lengthy; the more important hosts are plum, peach, apricot, pear, currant, blackberry, mulberry, osage-orange, elm, ash, linden, pecan, maple, *Cornus,* etc.

The Oak Lecanium

Lecanium quercifex Fitch

Plate 19, Fig. 9

Lecanium quercifex Fitch, 5th Rep. Ins. N. Y., p. 25 (1859).
Lecanium quercitronis Fitch, 5th Rep. Ins. N. Y., p. 25 (1859).
Lecanium antennatum Sign., Ann. Soc. Ent. Fr. (5), III, p. 413 (1873).
Lecanium pruinosum var. *kermoides* Tyrrell, Rep. Cal. Exp. Sta., p. 256 (1896).

Fitch's two species were described from white and black oak respec-

tively, but the types are identical. This very convex species seems restricted principally to oaks for the writer has attempted several times to transfer it to several other trees but failed to obtain adults, though the larvæ lived for some time on the strange host-plants.

This species is very convex, sometimes broader at the summit than at the point of attachment; light brown with a variable dark marking in the mid-dorsal region. The antennæ and legs are unusually long and slender; the derm pores (see photomicrograph) are rather large and regularly scattered but far apart; the spiracular and marginal spines are more slender than in *corni* or *pruinosum*. This species can be recognized by the three or four apparent scars near the outer angles of the anal plates, which otherwise are quite similar to those of *L. corni*.

The range of this species is very general, but it is of particular economic importance to the oaks in the south Atlantic and Gulf states. Signoret described his species *antennatum* from specimens on oak sent to him by Fitch from New York state.

The Globular Scale

Lecanium prunastri (Fonsc.)

Coccus prunastri Fonsc., An. Soc. Ent. Fr., III, p. 211 (1834).
Lecanium prunastri Sign., An. Soc. Ent. Fr., V, p. 423 (1873).
Lecanium rotundum Sign., An. Soc. Ent. Fr., V, p. 428 (1873).
Eulecanium prunastri Fernald, Catalogue of Coccidæ, p. 193 (1903).

This almost globular, small dark-red species is fairly common in Europe, but is found in few localities in the United States outside of Pennsylvania, where it has been known for a number of years. It infests principally plum, cherry and peach, and is remarkably gregarious in habit.

The best microscopic character of this species is the compound row of 100 or more small derm pores extending anteriorly from the anal plates. A stained specimen shows this character more satisfactorily than an untreated one.

The Terrapin Scale

Lecanium nigrofasciatum (Pergande)

Plate 19, Fig. 6

Lecanium nigrofasciatum Perg., Bul. 18, n. s., Bur. Ent., U. S. Dep. Agr., p. 26 (1898).

The original description of this native scale in the above reference and Circular No. 88, of the U. S. Bureau of Entomology, containing

a popular discussion and a short technical description of the species, are available to most entomologists, so that an extended discussion in this paper is hardly necessary.

Previous to Mr. Pergande's description of this species, it had been for many years confused with *Lecanium persicæ* of Europe, on account of its frequent occurrence on peach trees in this country. At present its general range is limited to the eastern half of the United States, including a few states just west of the Mississippi River. Its food plant list is large and comprehensive, including some of our most important economic and ornamental trees and shrubs.

Its habit of overwintering on the branches of its host plant, in a half-grown stage, is unique among Lecaniums. In microscopical details this species shows relationship with the genus Toumeyella and with Lecanium, and in view of its remarkable life history it may some day require a new genus for its proper reception.

The Tulip Soft Scale

Toumeyella liriodendri (Gmel.)

Plate 19, Fig. 3; Plate 20, Fig. 5

Coccus liriodendri Gmel., Syst. Nat., Ed. XIII, p. 2220 (1789).
Lecanium tulipiferæ Cook, Can. Ent., X, p. 192 (1878).
Lecanium tiliæ Cook, Ent. Amer., I, p. 211 (1885).
Eulecanium tulipiferæ King, Can. Ent., XXXIV, p. 60 (1902).
Eulecanium liriodendri Fernald, Cat. Coccidæ, p. 190 (1903).

A tree badly infested with this species presents a more disgusting appearance than any other of our common soft scales. Although quite confined to *Liriodendron tulipifera* as a host plant, it occasionally is found on Magnolias, but is easily distinguished from the larger, flatter magnolia soft scale by its very convex irregular form and dull clay-yellow color.

This species has been erroneously classified in Eulecanium. The character of its antennæ and legs which are reduced to mere stubs preclude any relationship with *Lecanium persicæ, L. prunastri,* etc., but instead relegates it to the genus Toumeyella, with which group it has derm characters in common.

This species was first described in Europe as *C. liriodendri* from Liriodendron trees imported from America, then about a hundred years later was described in America under the name *tulipiferæ*. During these years these two names have been held as representing distinct species, and more recently have been placed under the subdivision Eulecanium where they have no relationship.

The Magnolia Soft Scale

Neolecanium cornuparvum (Thro.)

Plate 19, Fig. 13; Plate 20, Fig. 6

Lecanium cornuparvum Thro, Bul. 209, Cornell Exp. Sta., p. 216 (1903).

This large flat scale has been erroneously determined and discussed by a few writers under the name *L. magnoliarum*, and has existed scientifically undescribed until 1903, although not an uncommon insect. It occurs on various species of Magnolias, including the deciduous *M. acuminata* of the Northern States. The pink color of the growing female scale is somewhat hidden by the covering of fine powdered wax, which also fills the spiracular grooves on the ventral surface and remains as four distinct white lines after the removal of the scale from its host.

The adult females average 8—10 mm. long and 5—8 mm. broad. When cleared and mounted the derm is seen to be crowded with large pores, and the very short reduced antennae and legs are scarcely noticeable.

It has been reported from New York, Ohio, Pennsylvania, Maryland, Virginia and Louisiana.

A NEW ENEMY OF THE FLORIDA ORANGE

By E. A. Back, *Orlando, Fla.*

The purpose of this notice is merely to call the attention of Entomologists to the discovery for the first time in this country of another pest of the citrus tree. In view of the widespread havoc played among the orange groves of Florida by the Citrus white fly, *A. citri* Riley and Howard, and the Spotted-wing, *A. nubifera* Berger, the discovery of another Aleyrodid which already has demonstrated itself to be of economic importance is interesting.

While recently examining orange trees along several streets in the business section of Tampa in connection with the white fly investigations being carried on in Florida by the Bureau of Entomology, the attention of the writer was attracted to dense white or grayish woolly secretions concealing the under surfaces of many leaves. At first this was supposed to be a heavy infestation of the usually scarce *Paraleyrodes perseæ* Quaintance, but on closer examination proved to be *Aleyrodes howardi* Quaintance, which until the present time has been known only to infest the orange trees of the West Indian Islands. In

Cuba it was first noted in 1903 by Mr. E. A. Schwarz, at Havana; and later, in 1905, by Mr. C. L. Marlatt at Artamisa, and at Santiago de las Vegas by Dr. Mel T. Cook.

Very little is known of the capacity for injury possessed by this Aleyrodid. Mr. C. L. Marlatt found it quite abundant locally on several of the old orange trees at Artamisa, but at that time, 1905, noted that it had spread but slightly into the surrounding younger groves. When describing it for the first time, Mr. A. L. Quaintance stated that judging from its abundance on leaves sent the Bureau of Entomology from Cuba it was a very serious pest of the Cuban orange, perhaps rivaling the Citrus white-fly of Florida. Whatever damage it is causing in Cuba, where it may be partially controlled by parasitic and predaceous enemies, it has shown itself capable of rapid multiplication and spread in its new home at Tampa. Notwithstanding the fact that it has not been observed in Florida before, although the same trees upon which it is now so abundant were casually examined by the writer in 1907 and 1908, it has become well established over a very large portion of the city, spreading northward beyond Michigan Avenue and eastward into Ybor City. Trees across the Hillsboro River, on the grounds of the Tampa Bay Hotel, are well infested, hence it is safe to presume that the pest is well established in the western part of the city.

From the present infestation it is quite apparent that the insect first became established near the water front. In this section neglected worthless trees along the streets and in door yards are in many cases very heavily infested. While it appears to be rivaling the Citrus white-fly in the extent of its attack on some trees, it is improbable that it is capable of causing so widespread disaster to citrus trees. Yet if it once becomes abundant in a grove, it will prove a source of no little aggravation and discomfort to those working in the trees because of the large and extremely vicid drops of honey dew which collect over the bodies of the insects, and later become embedded in the copious waxen secretions.

A more technical paper, with descriptions and drawings, is being prepared for early publication as part of the series of technical bulletins being issued by the Bureau of Entomology.

NOTES ON THE PARASITES OF THE SATURNIIDAE[1]

By W. F. Fiske and W. R. Thompson.

The main object under way at the Gypsy Moth Parasite Laboratory at Melrose Highlands, Mass., as is generally well known, is the importation and colonization of the parasites and predatory insect enemies of the gypsy moth and the brown-tail moth. Studies of the biology and habits of the various parasites and predators have been undertaken whenever opportunity permitted or necessity demanded, and in addition, when it could be done without prejudice to more important work, occasional studies have been made of the parasites of native insects. The result has been the accumulation of a quantity of notes upon the general subject of parasitism in its relation to the natural control of insects, and upon the biology and inter-relations of the parasites themselves. The knowledge thus gained has been of considerable practical assistance in the prosecution of the work on numerous occasions.

It has been the rule to select as subjects for such minor investigations those insects which most closely approached the gypsy moth in habit or in their natural affinities. American representatives of the family Liparidæ, whenever they could be secured in sufficient numbers to make the results representative of the conditions, have received particular attention, while the fall web worm, tent caterpillars, etc., have come in for a lesser share. The native silk worms, on account of their dissimilarity to the gypsy moth were not considered as subjects for such a study until the publication of Dr. Smith's paper on the parasites found in *cecropia* cocoons in the Journal of Economic Entomology for October, 1908, suggested it.

Credit for its inception is due to Mr. C. H. T. Townsend, at that time associated with the laboratory, who desired particularly to secure additional data upon the Tachinid parasites of these hosts, and upon their hibernating habits. In the preparation of the notes for publication the junior author undertook the compilation of the statistical data on percentage of parasitism in various localities, etc., and also completed the study of the Tachinid parasites which was begun by Mr. Townsend before he severed his connection with the laboratory to accept a position with the Peruvian government. For the collection of material the authors are wholly indebted to the officials and fieldmen associated with the work against the gypsy moth and brown-tail

[1]Occasional Contributions from the Gypsy Moth Parasite Laboratory, I. Published with the approval of Dr. L. O. Howard, Entomologist, U. S. Department of Agriculture.

moth in Massachusetts, and to the agents and employees of the Bureau of Entomology, similarly employed in Massachusetts and New Hampshire.

Although exact comparisons are, of course, impossible, there is little doubt that *cecropia* is very much less common in southeastern New England than it was in those sections of Long Island and New Jersey from which Dr. Smith secured his material. The collection in eastern Massachusetts or southern New Hampshire of as many as 1,000 cocoons would have been an almost herculean task. The total number of cocoons received from a considerable number of men regularly engaged in field work, who were instructed to collect and forward to the laboratory any that they might find, was only 370, without counting those a year or more old. In addition there were 997 cocoons of *promethea* and 40 of *polyphemus*.

Material was received from a large number of towns, scattered over a territory of considerable extent. A few more from the shores of Buzzard's Bay, many from the more central sections of the state east of Worcester, but the larger number from the northeastern towns, along the shore and in the lower valley of the Merrimac. The New Hampshire material was nearly all from the valleys of the Merrimack and Suncook rivers.

Comparison between the cocoons of *cecropia* received from these various localities and those studied by Dr. Smith as regards the prevalence of parasitism, death through other causes, etc., is interesting, and is as follows:

	New Jersey and Long Island		Mass. and New Hampshire	
	Number	Per cent	Number	Per cent
With healthy pupæ	36	3.5	151	41
Dead but not parasitized	697	68.	96	26
Parasitized	295	28.5	123	33
Total	1,028	100	370	100

It will be noted that the percentage of parasitism in the two lots is not particularly different, but that the proportion of healthy pupæ in Massachusetts and New Hampshire is very strikingly larger. This is, apparently, a confirmation of Dr. Smith's conclusions concerning the relative effectiveness of parasites versus other causes in the control of this insect, and would seem to support the theory that the parasites were less mobile, and therefore less active agents in natural control. A comparison between the condition existing in Massachusetts and New Hampshire, respectively, in the winter of 1908–1909 does not support this contention, however, as may be seen by the following:

	Massachusetts		New Hampshire	
	Number	Per cent	Number	Per cent
With healthy pupæ	132	45.8	19	23.2
Dead but not parasitized	74	25.7	22	26.8
Parasitized	82	28.5	41	50.
Total	288	100	82	100

In this comparison it will be noted that the percentage of dead from other causes than parasitism remains almost exactly constant, while that of parasitism is more than three fourths greater in New Hampshire, or almost twice as large. It would have been better had the number of cocoons from New Hampshire been larger, since it would have lessened the chances for error, but the relative condition of the *promethea* cocoons, similarly compared, as will be seen by the following tends to substantiate the results with *cecropia:*

	Massachusetts		New Hampshire	
	Number	Per cent	Number	Per cent
With healthy pupæ	254	41	46	15
Dead but not parasitized	137	22	70	23
Parasitized	231	37	192	62
Total	662	100	308	100

The number of cocoons thus classified falls a little short of the 997 which was mentioned as the total number studied, as there were a few of somewhat doubtful origin. The greater proportionate destruction by parasites in New Hampshire is quite as strikingly brought out in this comparison as in the other, and it is worthy of note that the parasitism of *promethea* was uniformly higher than of *cecropia* under all conditions, and the death through causes other than parasitism lower.

An attempt was made to determine whether the percentage was uniformly higher or lower than the average in restricted regions, as, for example, in the lower Merrimac Valley or along the "North Shore" in Massachusetts. The results were all negative, and instead of supporting the proposition tended strongly to indicate that immediate local conditions had very much to do with the matter. Enormous variations in parasitism were found in different lots from the same town or from towns closely adjacent, and the only conclusions which could be drawn from the considerable series of careful computations which were made are that the *average* percentage of parasitism was greater to the north than to the south, although there were frequent exceptions to the rule. The futility of attempting to draw general conclusions from a study of material from one locality seemed to be well demonstrated, and it is likely that this will apply equally well to other insects than those studied.

The Primary Parasites

The list of primary parasites which were reared or otherwise secured from the several hosts is included in the following table, together with the numbers, gross and proportionate from each:

	Promethea		Cecropia		Polyphemus	
	Number	Per cent	Number	Per cent	Number	Per cent
Ophion macrurum	326	32.7	27	7.3	4	10
Spilocryptus extremis	109	10.9	4	1.1	1	2.5
Theronia fulvescens	4	.4				
Diglochis omnivorous			2	.5		
Tachina (?) sp.	5	.5	46	12.4	1	2.5
Achætoneura frenchii			44	11.9		
Total	444	44.5	123	33.2	6	15.

The most surprising feature of this list is the very considerable percentage of parasitism of *cecropia* by Tachinid flies, amounting to nearly three times the total parasitism by Hymenoptera. There are at least two species, the larvæ of one of which pierce the cocoon of the host and drop to the ground for pupation, leaving as characteristic evidence of their occupancy the exit hole in the cocoon, the first and second stage moult skins within the host remains, and frequently, but by no means always a few dead maggots which were too weak to accompany their healthier companions. None of these signs are conspicuous, and all might be overlooked in a casual study of the cocoons, and it is easily possible that a portion of those studied by Dr. Smith may have been parasitized by the same or another species with similar habits.

No adults of any species having this habit were reared. An examination of the larvæ which were left behind makes it probable that they were all of one species, and possibly that they are to be referred to the genus Tachina, as they possess very many of the characters of *Tachina mella* Walk.

The other species which is about equally abundant pupates within the cocoons, and has been determined as *Achaetoneura frenchii* W. Not all of the puparia hatched, but from the 44 cocoons a total of 550 flies, an average of between 12 and 13 from each, were reared. If it had been present in the New Jersey or Long Island material it would most certainly have been observed, and its absence is worthy of comment.

The average number of flies issuing from one cocoon is no indication of the number which may sometimes mature on one host. In one instance Mr. Townsend counted no less than 90 puparia from which the flies had emerged and in another he found and counted

exactly 147 dead maggots in a single *cecropia* caterpillar. This last is a particularly interesting instance of the disastrous results which frequently follow double parasitism of an individual host by the same species of parasite, the 147 maggots probably representing the progeny of several females.

They were sufficient, had they been distributed judiciously, to have parasitized successfully at least 8 caterpillars. Concerted attack upon a single individual resulted in the death of all and illustrate in a striking manner the consequences which follow too rapid increase of any parasite in proportion to the increase of the host. Even in the other instance mentioned, in which 90 flies completed their transformations, the puparia were so small as to make it certain that the flies were undersized, and presumably, since it holds with Hymenopterous parasites under similar circumstances, proportionately weak.

As may be seen by reference to the tables, the Ophion was the most common of the Hymenopterous parasites outranking all of the other species taken together. As in Long Island and New Jersey, the apparently specific disease which attacks the larvæ sometime after they have spun their cocoons and before the discharge of the meconium, and which is characterized by the reduction of the body into a mass of semi-liquid filth, was extremely prevalent. As Dr. Smith truly says, the condition is by no means unusual, and the continued existence of the species in spite of the adverse conditions is rather remarkable, if, as seems probable they are the rule rather than the exception. The struggle for existence is further accentuated by the habit of oviposition in young or only partly grown caterpillars. The first stage larvæ have been found upon several occasions in caterpillars which were not nearly half grown, and if this is habitual, as it probably is, the parasite is subject to all of the vicissitudes which beset its host during the later larval period.

Dr. Smith records an emergence of something like 25 per cent, which is very far in excess of the number completing their transformations in Massachusetts and New Hampshire, as indicated by the collections of cocoons. Out of the 350, only two adults were secured, or less than 1 per cent of the total. Death was not due in every instance to the disease, secondary parasitism being fairly frequent, but the total thus destroyed could not have amounted to 10 per cent. It is possible that the species is frequently parasitic upon some other host better suited to its needs than is *cecropia* or *promethea*.

Spilocryptus was generally healthy, and emergence probably amounted to at least 90 per cent of the total except in instances

when the cocoons were injured or used for experimental purposes. Secondary parasitism was of fairly frequent occurrence, but probably amounted to less than 5 per cent.

The new light which was thrown upon that most remarkable parasite, *Theronia fulvescens* as a result of these investigations was in itself almost sufficient to justify the undertaking. The species has variously been recorded as primary and secondary in its relations with different hosts, and the apparently incontrovertible evidence which has been adduced in support of both contentions has been, to say the least, very perplexing. It is of particular interest, since it is the most common parasite of the gypsy moth native to America, and in nearly every instance it appears to be primary in its relations to this host. *Theronia atalantæ,* in Europe, and other closely allied and possibly identical species in Japan are indistinguishable in their early stages, and while they are relatively insignificant parasites of the gypsy moth in their respective countries, they are about as common as *T. fulvescens* in that connection.

So far as known the adults always hibernate, and in consequence no living larvæ or pupæ were found in any of the cocoons which were opened. There were twenty cocoons which contained dead adults or pupæ, or from which the adults had escaped leaving their characteristic, rudimentary cocoons of dark brown silk as certain indication of their former presence. Twelve contained dead, fully formed adults, which had been unable to escape through the dense silken walls. Two contained dead pupæ, and from six only had the adults emerged successfully. It is obvious that the host is not particularly well adapted to the parasite when above 50 per cent are unable to effect their escape after completing all of their transformations, but the phenomenon presented is not out of keeping with other, somewhat similar observations which have been made, and which go to show that the discretionary powers possessed by the parent females of parasites generally are decidedly limited.

In four out of the twenty instances, Theronia was apparently primary, and there seems not to be the slightest doubt that it was so in one instance in which the dissection of the host remains, for the purpose of discovering traces of any other parasite which might have been present, was so thorough as to result in finding all three larval moult skins as well as the pupal exuvium. In three out of the four it was internal in the *promethea* pupa, in the other it appeared to have fed externally upon the caterpillar prior to pupation.

In a single instance a dead Theronia, in the form of a fully colored

pupa was found within the cocoon of Spilocryptus, upon the larva of which it had fed, and in the remaining fifteen it was apparently a secondary upon Ophion. It may have been truly what it seemed, that is hyperparasitic, or it may have been that its occurrence in this rôle was purely accidental, and that in oviposition the female selected the cocoons irrespective of the character of their contents. Most frequently the Ophion larva was overcome before it had completed its cocoon, but in several instances the Theronia escaped, or attempted to escape through the perfectly formed cocoon. The preponderance of the instances in which Theronia appeared to be secondary is quite what would be expected, owing to the longer period during which Ophion would be open to attack. It is believed that after the *promethea* has pupated, and the pupa is hardened, that it is immune, and that oviposition can only be successful when the prepupal caterpillar or perfectly fresh pupa is selected. Ophion, on the contrary, since it hibernates as a larva, is open to attack at any time during the fall.

Only two of the pupæ of *cecropia*, and none of the other hosts were attacked by Diglochis, and in both instances, while the number of larvæ of the parasite was sufficient to kill the host, there were not enough nearly to consume it. As a consequence the larvæ and pupæ, surrounded by the unconsumed and decomposing matter, nearly all died. A very few adults which were reared oviposited with great freedom upon the pupæ of *promethea* to which they were given access. It is certain that they would attack this host as well as *cecropia* in the open, were it not for the protection afforded by the cocoons.

Inter-Relations of the Primary Parasites

A considerable amount of evidence has accumulated during the past three summers at the laboratory which tends strongly to support the contention that the prescience of the female parasite is insufficient to enable her to distinguish between parasatized and unparasitized hosts for her progeny. If this be a fact, the result must be that an individual host is frequently attacked by two different species of parasites, or as has been presupposed in the instance of the 147 Tachnia maggots already mentioned, by the same species more than once. Instances of double parasitism are, in fact, of frequent occurrence, and a study of the results in specific instances are often very interesting. Several rather novel examples were encountered in the present study.

The apparent secondary parasitism of Ophion by Theronia is

believed to be an instance of this sort, and so far as known the former is always the victim in such a conflict. The same is true of Spilocryptus, undoubtedy a primary parasite and to be considered as such. In several instances in which it was found in the same cocoon as Ophion, it destroyed the larva, feeding upon it as an external parasite, exactly as it would have done upon the caterpillar had it remained alive. In one instance the cocoons were found massed within that of the Ophion, but usually the Ophion cocoon was incomplete or entirely lacking. In one instance no less than 10 healthy larvæ reached maturity; usually they were less, and sometimes only a few, or none at all completed their development. The most interesting examples were found in old cocoons, from which all the living parasites had escaped.

The outcome of double parasitism by Spilocryptus and Theronia depends upon which is the first in the field. It is very probable but unproven that the young, internal feeding Theronia is destroyed by the external feeding Spilocryptus through deprivation of its food supply. In one very extraordinary instance the Theronia reached full development as an internal, and the other as an external parasite, a state of affairs never before met with. In another, in which the Spilocryptus was obviously the first to attack, a dead Theronia was found in one of the several cocoons of the other.

A study of the host remains in cocoons which had been attacked by any of the parasites would probably result in the discovery of evidences of attack by other species which had been destroyed in such an early stage in their development as to leave no conspicuous remains. Spilocryptus, for example, is undoubtedly the victor in some instances in which it conflicts with the Tachinid parasites. In others it is likely to die as a result of the premature death of the host. Ophion invariably kills its host before pupation, and the Tachinids frequently, though not always afterward. There is a possibility, since it is the first to mature, that occasionally it triumphs over them, but this is not always the case. In two most remarkable instances, it was, as usual, the victim.

In each of these the Ophion cocoon, normal in appearance and texture, was found in its usual situation within cocoon of *cecropia*, and the walls of both were pierced by the characteristic exit hole of the Tachinid maggots. The Ophion cocoon was empty, except for the skin of the larva, and in spite of the almost conclusive evidence that Tachinid maggots had somehow gained entrance and destroyed the occupant, the circumstances were so remarkable, and altogether out

of keeping with the ordinary, as to demand additional substantiation. Careful examination of the contents of one of these parasite cocoons discovered nothing (the other was unfortunately lost) but when the remains of the primary host were examined a quantity of second stage Tachinid moult skins, and one dead and dried Tachinid maggot were found. It seemed to prove conclusively that the maggots, threatened with starvation through the more rapid development of their common rival, had migrated into its body, and there continued their development exactly as they would have done had they remained in undisputed possession of their original host. Additional color is given to this conclusion by another instance involving the parasites of an entirely different host, in which the young larva of one is known, beyond peradventure of doubt, to have entered in a similar manner the body of a rival.

The Secondary Parasites

Nothing approaching the tremendous percentage of hyperparasitism recorded by Dr. Smith was encountered in the course of this study. Dibrachys, of which he reared scores of thousands, is a very common hyperparasite throughout southern New England, but was very rare in this connection. One mass of Spilocryptus cocoons a year or more old was found to have been infested, and a few dead pupæ and adults found. A very few were also reared from a few masses of the Spilocryptus cocoons which had been torn from their original position in the cocoons of their hosts, and placed together in a small cage. These immediately oviposited in the still dormant larvæ of the primary parasite, and a very much larger number of the second generation were reared.

Even when Spilocryptus was collected in mid-winter and exposed to continuous high temperature until spring it did not complete its transformations until after the press of regular spring work had made further observations impracticable, and the date of its usual emergence in the open is not known. It is very likely not until well into June in this latitude, and Dibrachys which only requires one month of average late spring temperature in which to complete its life cycle has ample opportunity to complete one generation and probably two before its host resumes activity. Unlike that species, it responds almost immediately to "forcing" during the winter, so that no time is wasted in making a start. It is likely, too, that only in somewhat exceptional instances is it able to reach the well protected cocoons of the Spilocryptus, since it has not been known to gnaw its way through

any obstacle for the purpose of oviposition. There is reason to suspect, therefore, that Dr. Smith unwittingly supplied a comparatively few females which were actually reared from his material with conditions peculiarly suitable for their rapid reproduction, with the extraordinary results which he chronicles.

Bathythrix pimplae, originally described by Dr. Howard from a few specimens reared by him from cocoon masses of the tussock moth, and considered to be a parasite of *Pimpla inquisitor,* was reared in rather small numbers in the aggregate from the cocoons of Spilocryptus. Usually only one or two cocoons in each mass were attacked, and two or three of the secondary usually came from each individual host cocoon. Like Dibrachys, Bathythrix responds almost immediately to forcing, and the females are able to oviposit for two generations in the sluggish larvæ of the Spilocryptus. It is very probable that there is at least one full generation in the spring, and possibly two or more.

Hemiteles periliti Ashm. was occasionally encountered as a parasite of Spilocryptus, and in one very remarkable instance, of Ophion. No living specimens were secured, and since it was difficult positively to distinguish its cocoon exuviæ, etc., from those of Bathythrix, its identity could only be established through the occasional dead adults found. The occurrence of a dead adult within the cocoon of Ophion established this record indisputably, and it is indeed remarkable that a species which can successfully mature within the cocoon of a minute Apanteles can also attack a host at least one hundred times larger than itself.

An undetermined species of Pimpla was reared in very small numbers from the old cocoon masses of Spilocryptus, within which it had apparently passed a considerable portion of the previous summer. It was thought possible that the record was based on error, and that the actual host was some other insect which had sought the shelter afforded, but later another individual was reared from a cocoon of Ophion, and its identity as a secondary parasite associated with *promethea* was definitely established.

Another secondary parasite, not yet determined, but belonging to the exceedingly remarkable genus Perilampus, was reared from the puparia of *Achaetoneura,* from the cocoons of *cecropia.*

Spilochalcis, which was reared by Dr. Smith in some numbers appears to be a rather uncommon insect in southeastern New England, and no surprise was felt in not encountering it at all in this work.

Conclusions

It was hoped to supplement the winter work on the cocoons of these moths with a study of the parasites which attack the immature caterpillars and eggs during the summer, but it was found to be wholly impracticable. Egg parasites are known to exist, and probably those which will attack one species will breed with equal freedom in all. In several instances the eggs of *promethea,* which are somewhat easier to find than those of the others, owing to their being deposited in some numbers together, have been found with exit holes of some parasite. It is quite possible that parasitism of the eggs is at times a considerable factor in the control of the host.

The parasites of the young caterpillars are hardly better known. There is one which is related to Apanteles which issues from the first and second stage caterpillars of *luna* and *polyphemus* and possibly attacks the others also, but the cocoons have usually been hatched, or have been attacked by secondaries when discovered. It appears to be rather abundant. A Limnerium attacks the caterpillars of *promethea* before they are half grown and may attack the others also, but no attempt has been made to collect and rear it.

Altogether it would appear from the very limited observations which have been made, that the parasites of the immature caterpillars outrank in importance those which attack the larger caterpillars and pupæ, but until more is known concerning them, and the part which they play in the control of their common or respective hosts, it is impossible to draw any conclusions as to their relative effectiveness.

The percentage of parasitism indicated by the study of the cocoons was greater than was expected, and it is believed that the extraordinary variation in the percentage thus destroyed in different localities is indicative of the importance of this group of parasites as a factor in natural control.

PROGRESS OF THE NATIONAL INSECTICIDE BILL

At the last session of the Association of Economic Entomologists the committee on insecticides reported that a bill for the federal control of the purity of insecticides had been introduced into Congress and had the support of the leading manufacturers[1].

The measure introduced into Congress was originally suggested by the insecticide committee of the Association of Economic Entomologists which called a conference of manufacturers, entomologists and agricultural chemists which met at New York, June 18, 1908. This conference appointed an executive committee to represent it in pushing the passage of the bill as amended by the conference before Congress. This committee consists of the following:—E. D. Sanderson, Chairman, and H. E. Summers, representing the Entomologists; J. P. Street, Chemist, Conn. Agricultural Experiment Station, representing the agricultural chemists, and H. F. Baker, Pres. Thomsen Chemical Co., Baltimore, Md., and R. G. Harris of the Grasselli Chemical Co., Cleveland, Ohio, representing the manufacturers. The committee has recently sent out the following report of progress to all parties interested:

The committee met at New York, July 23, 1908, organized, and appointed an advisory member in each state to secure support for the bill. The bill as amended was at once printed and given general circulation among agricultural and horticultural organizations and the agricultural press. The committee met at Washington, D. C., November 16, 1908. Methods of introducing the bill in Congress were discussed and tentative plans therefore were made. Objections having been made to the standard for arsenate of lead as defined in Sec. 6, of the bill, a meeting was held at the Hotel Belmont, New York, December 8, 1908, to which all the manufacturers were invited to consider the same, and this section was finally unanimously amended to read as found upon the bill, favorably reported by the Senate Committee on Agriculture and Forestry. Messrs. Baker and Sanderson were appointed by the committee to visit Washington when necessary to aid in the passage of the bill and to call a meeting of the whole committee whenever a hearing before Congressional Committees could be secured. They visited Washington, January 14 and February 4, 1909, and with others called upon the gentlemen who had introduced the bill and the members of the committee to

[1]See Journal Economic Entomology, Vol. 2, page 224.

whom it had been referred. On the latter date, it was found that the bill had been favorably reported to the Senate, but conference with influential members of the House Committee on Interstate Commerce, to which the bill had been referred, showed that it would be useless to attempt to secure a hearing or push the bill in the House during the short session. Owing to the pressure of business during the last month, the bill did not come to a vote in the Senate.

During the recent special session the bill was again introduced in the House by the Hon. E. A. Hayes, of California—H. R. 2218.

The agricultural and horticultural interests of the country supported the bill before Congress most loyally. Practically all the leading agricultural and horticultural organizations have heartily endorsed the measure and the agricultural press has given it cordial support. Your committee believes that with united effort the bill can be made law at the coming session of Congress and asks your continued support to the end.

On November 18 the committee held a conference of all the leading manufacturers, practically all of whom were represented, who again unanimously supported the bill with one or two minor amendments. There can be no doubt that the leading manufacturers are heartily in favor of the passage of this legislation. Its adoption by Congress will depend almost entirely upon the demand made for it by the horticultural and agricultural interests of the country. The Association of Economic Entomologists has already endorsed this measure and it has been endorsed by all the leading agricultural organizations of the country. The entomological representatives on the committee would therefore urge that the entomologists use their best influence with their constituents toward calling the matter to the favorable attention of Congress. A hearing before the House Committee on Interstate Commerce will be secured at the earliest possible moment in December and we hope to be able to report further progress at the meeting of the Association in Boston.

E. D. SANDERSON.

NOTES ON TWO INSECTS FOUND ON CORN

By R. L. Webster, *Ames, Iowa*

In some notes made during last year, 1908, I find that two insects are mentioned as being found on corn, the occurrence of which I have been unable to find any other record. Since the two species are not mentioned in the 18th or 23d reports of the Illinois State Entomologist (Forbes Corn Insects) it may be worth while to record the following data:

Hemerocampa leucostigma S. & A. A nearly mature larva of the whitemarked tussock moth was found on a corn leaf in a field of corn near the college on August 31st. The leaf was partly eaten when found, and the larva continued to feed on it after taken to the insectary. The larva completed its transformations and a female moth emerged September 21st.

Aphis setariæ Thos. On July 1st a winged form of this species was found on a corn blade in a field near Ames. The aphid had produced several young, all of which were brought to the insectary and placed on a corn plant. These, however, died within a few days.

On July 7th I found both winged and wingless adult forms on blades of corn, of which two the winged form had several young beside it. These specimens were placed upon corn in the insectary. On the same day Mr. C. E. Bartholomew brought in winged and wingless forms of *Aphis setariæ* Thomas, which were at that time very common upon plum. A comparison between the aphids on the corn and those on the plum showed them to be the same.

In the insectary these aphids failed to live upon corn for any length of time. In the field they were found but sparingly, and always with very few young in the colonies. The fact that apterous adults were found on corn indicates that the species is able to live upon that plant long enough to attain maturity. Later in the season *Aphis setariæ* was found common on *Setaria glauca* and *Panicum crus-galli*, as well as upon plum, in the vicinity of Ames.

Diabrotica longicornis Say. While on a field trip in the northern part of the state in September this year I spent some time looking for the beetles of the northern corn root-worm, which is practically unknown in that part of the state. After an hour's search in a cornfield in northern Kussoth County, Iowa, I found a single adult within a quarter of a mile of the Minnesota line. I believe that the species has not been recorded in Minnesota.

Discussion and Correspondence

The following communication has been received from Mr. Nathan Banks:

I do not know as it is of any use to say much about Dr. Nuttall's statements on page 361, JOURNAL OF ECONOMIC ENTOMOLOGY, 1909. Anyone who uses the work can see readily how largely it is a compilation and not a monograph. Dr. Nuttall says that of the eleven valid species of Ornithodoros they have studied eight. Of the three valid species that they do not know, specimens of two are in the Paris Museum, and the type of the other is in Berlin; all were studied by Dr. Neumann. Moreover there are three "doubtful" species, the type of one is in Berlin, and Dönitz states it has a good structural character. The two other doubtful species were described by Birula (St. Petersburg). Dr. Birula is alive and available, and in a similar case where the present writer was in doubt about one of Dr. Birula's species (*Ixodes signatus*) he wrote to that gentleman and obtained a cotype of the species.

Besides the five species of Argas seen by Dr. Nuttall there are two species described by Dr. Neumann, the type of one in Paris, the other in Berlin, while another species, classed "doubtful" by Dr. Nuttall, has been identified by Dr. Neumann from numerous specimens in the Paris Museum. To receive some material from a museum, and to go to that museum and study the type-material are very different matters. After the description of *O. turicata* we read, p. 59. "Neumann's description from which the above is partly taken," etc.

After the description of *O. talaje* we read, p. 60. "The foregoing description (condensed from Neumann, 1896, p. 34-36) is based on the examination," etc.

After the description of *O. erraticus* we read, p. 64. "Neumann's description, from which the above is taken," etc.

After the description of *O. thalozani* we read, p. 66. "The above description of the adult and nymph are condensed from Neumann," etc.

After the description of *O. megnini* we read, p. 75. "The foregoing description of the adult is partly based on that of Neumann," . . . "that of the nymph on the description of Neumann and Salmon and Stiles."

Is this the way to prepare a monograph? A monograph represents original work, largely on type material; a going behind the descriptions of others, not a compilation from them; an examination of the

material upon which other descriptions were based, verifying synonymies, etc.

I have not stated nor implied that Dr. Nuttall did not give sufficient credit. One has only to consider that 12 of his 45 original figures refer to one species, and seven others to another species to see how largely he has depended upon others, for illustration,—Nathan Banks.

THE ROSE CURCULIO (RHYNCHITES BICOLOR FAB.) IN MASSACHUSETTS[1]

By Burton N. Gates, Ph. D., *Bureau of Entomology, Washington, D. C.*

During the spring of 1909, while at Clark University at Worcester, Mass., I had an opportunity to make certain observations on this insect which it is hoped will draw attention to its presence in injurious numbers and lead to a more thorough knowledge of this species.

In Massachusetts the rugosa or Japanese rose is usually quite exempt from insect attacks. During the present summer (1909), however, apis species and the rose-curculio (*Rhynchites bicolor* Fab.) became common upon it. It was the prevalence of this beetle which especially attracted the writer's attention.

The curculio was first noticed late in May, and in June became more numerous. By thrusting their snouts into the swelling rosebuds the adults ruined practically every bloom in the vicinity of Worcester. Some blossom clusters had as many as twelve or fifteen beetles on them. Shortly after attacking the Japanese roses they appeared on the hardy perennial varieties, at the time when they commenced to show color. A week later the writer found the beetles on the wild roses in the fields of North Grafton. July 10, when leaving Massachusetts for Washington, Rhynchites were still numerous and active.

The unusual damage to roses this past summer was noticed by most growers, but was attributed to the common rose-chafer (*Macrodactylus subspinosus* Fab.[2]). Few persons, until their attention was called to Rhynchites, had noticed the invasion of the curculio.

The writer attempted hand-picking the beetles, but found that this method made little impression, as large numbers flew in from neighboring gardens. Furthermore, the behavior of the species, the habit of feigning death and dropping to the ground, made it impossible to gather all the beetles from a bush. Also, the prevalence of the curculio on wild roses precludes eradication or check by hand-picking. Consequently, it would appear that bio-

[1] The occurrence of this insect in two other localities not listed in Bulletin No. 27 of the Bureau of Entomology, referred to below, has been called to the author's attention. In Maryland, specimens were captured in August, 1898, at Boonesboro, Washington County (Western Maryland), and are preserved in the collection of the Maryland Agricultural Experiment Station. Mr. A. B. Gahan of this station says the species is common around Manhattan, Kan.

[2] Chittenden, F. H. The rose-chafer *Macrodactylus subspinosus* Fab. Bureau Entomology, Circular No. 11. Revised, July 16, 1909. 4 pp. Illus.

logical forces, such as enemies, diseases and meteorological conditions, must be relied upon to check or control this pest.

The feeding of Rhynchites was not confined to the rose flowers or buds, but extended even to clusters of tender, unfolding leaves, which became badly mutilated.

Several pairs of insects were seen mating. Although a special effort was made to observe egg-laying none were seen in the act.

A summary of observations on this insect may be found in Bulletin No. 27 of the Bureau of Entomology by F. H. Chittenden.[3] Specimens have been taken, according to Mr. Chittenden, in various places from the Pacific to the Atlantic, but no outbreak in Massachusetts is recorded. While this year may not be the first appearance of this insect in Massachusetts, it is the first time the damage has been general and noticeable in the central part of the state. Close watch will be kept for its re-occurrence in succeeding years.

NOTES ON HONEY BEES GATHERING HONEY-DEW FROM A SCALE INSECT, PHYSOKERMES PICEAE, SCHR.

BURTON N. GATES, PH. D., *Bureau of Entomology, Washington, D. C.*

It is known that scale insects as well as aphids secrete honey-dew. For instance, *Lecanium oleæ*,[1] upon the citrus fruits of California produce great quantities of honey-dew, which collects as a coating upon the leaves and is a medium for the growth of a fungus, *Capnodium sp.* The mycilium of this fungus sometimes forms a felt over the leaf, closing the stomata and thus killing the tree.

On the spruces at Amherst, Mass., a scale less well known than this black-scale attracted the writer's attention late in May and in June, 1908. Large numbers of bees were humming in the trees on the campus of the agricultural college. At times the roar was suggestive of a swarm. At first, however, it was thought from the behavior of the bees that they were collecting materials for propolis, but none were seen with a burden packed upon their legs. By following a single bee it was possible to see her on a twig at the union of the last two years' growth searching with extended tongue for something apparently sweet. At the base of what looked to be a bud the bees invariably worked as eagerly as at a drop of honey. This bud-resembling structure was crushed and immediately revealed animal tissue. There were thousands of these bud-like scales on the spruces and from them the bees were busily collecting a liberal store of honey-dew. Some scales, however, apparently produced more of the substance than others, because in some instances globules or dried crystals of honey-dew were noticed at the base of the insects.

Specimens were sent to Mr. J. G. Sanders of the Bureau of Entomology, who determined the scale to be *Physokermes piceæ* Schr., "a European species

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[3] Washington, 1901.

[1] Kellogg, Vernon L. 1905. American Insects. New York, Henry Holt & Co. VIII+674 pp. Page 187.

which affects the spruce trees and only recently has been introduced into the United States."[2]

The species is not likely to become a serious pest to the spruces, Mr. Sanders wrote, because of its numerous parasites. Consequently, bee-keepers will probably not be greatly annoyed with the honey-dew it produces as compared with the large amounts from aphids.

During the past summer (1909) the amount of aphid honey-dew stored by bees has been almost unprecedented in all localities east of the Mississippi, and especially northward. Reports in the apicultural periodicals show excessive production in Illinois, Indiana, Ohio, southern Michigan, Pennsylvania, New Jersey, Maryland and to some extent in New York and New England. In an editorial in *Gleanings in Bee Culture*[3] Mr. E. R. Root states: "The abundance of honey-dew [and the resulting admixture with pure honey] will make the year 1909 the shortest on a strictly clear white honey, east of the Mississippi and south of the Great Lakes, that we have ever known." He further adds: "Reports continue to pour in, showing that this is probably the greatest year for honey-dew ever known in this country."

[2] To his knowledge, it has been taken at three points in Massachusetts.
[3] Vol. 37, Oct. 1, 1909, p. 388.

JOURNAL OF ECONOMIC ENTOMOLOGY PUBLISHING COMPANY

The annual meeting of the stockholders of this company will be held on December 28th or 29th in connection with the Association of Economic Entomologists, at Boston, Mass. The precise time and place will be announced at the sessions of that association. Members of the Advisory Board are hereby notified that it devolves upon them to nominate the elective officers.

E. P. Felt, *President.*
E. Dwight Sanderson, *Secretary.*

JOURNAL OF ECONOMIC ENTOMOLOGY

OFFICIAL ORGAN AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS

DECEMBER, 1909

The editors will thankfully receive news items and other matter likely to be of interest to subscribers. Papers will be published, so far as possible, in the order of reception. All extended contributions, at least, should be in the hands of the editor the first of the month preceding publication. Reprints of contributions may be obtained at cost. Minor line figures will be reproduced without charge, but the engraving of larger illustrations must be borne by contributors or the electrotypes supplied. The receipt of all papers will be acknowledged.—EDS.

The forthcoming annual meeting of this Association promises to be one of absorbing interest to the economic entomologist. The program is literally crowded with valuable papers and the exhibit of entomological material and methods cannot fail to stimulate interest and lead to further improvements. A large attendance is assured and the mutual interchange of ideas which will result must have a marked influence on the science which we are all striving to advance. The benefits to be derived from participating in such meetings are more than personal; the member who attends receives first-hand information much of which he can transmit directly to his constituents for their own use in preventing loss from destructive insects. Thus the whole country, doubtless without realizing the fact, profits by these conventions.

Each year the Association had made a steady growth both in numbers and in the influence that it has exerted. The meetings have been characterized by harmony and unity of purpose and the future gives promise of even greater achievements than those that have characterized its progress in the past.

The JOURNAL OF ECONOMIC ENTOMOLOGY has proved its usefulness and at the end of the second year of its existence has become a firmly established and well supported publication.

All these facts should be a source of gratification to the members and should inspire all to unite in a common purpose to build up and develop the Association along practical and progressive lines.

Reviews

A MERITORIOUS WORK

F. V. Theobald has just published a very extensive work of 550 pages, profusely illustrated, on "The Insect and Other Allied Pests of Orchard, Bush and Hothouse Fruits." This work is so important that it should be in the hands of every economic entomologist in the United States, and more especially so as American economic entomologists should keep thoroughly informed regarding the injurious insects of neighboring countries, which are liable at any time to be accidentally imported into the States. The price is thirty shillings and orders should be sent to the author at Wyecourt, Wye (Kent), England.

L. O. HOWARD.

Insects Affecting Vegetables, by C. J. S. BETHUNE, Ont. Dep't. of Agric. Bull. 171, p. 1–64, 1909.

This very practical bulletin by a veteran in economic entomology gives brief accounts of the more common insects affecting garden vegetables, preventive and remedial measures being emphasized. The value of this publication is greatly increased by a similar discussion of fungous diseases and by directions for preparing the standard insecticides and fungicides. It can not but be most helpful to the readers for whom it is designed.

Spring Manual of Practice in Economic Zoology, by H. A. GOSSARD, O. Agric. Exp't. Sta. Bull. 198, p. 15–88, 1909.

This is the second in a series of important bulletins designed to assist the farmer in controlling not only insects but other animal pests and fungous diseases. The value of correct management, such as rotation of crops, clean farming, etc., is rightly emphasized at the outset. This is followed by brief discussions of various wild animals and methods of controlling the same. Special attention is given to birds. There are brief notes on the habits of the more important species and several paragraphs are devoted to a discussion of methods of attracting birds. Under farm treatment, the methods of controlling the various enemies of different crops are given in a summarized form. The discussion of methods to be employed with each important farm crop or group of crops is nicely summarized in tabular form. The author uses the season and crop as a starting point from which the farmer is expected to recognize the insect and select the proper treatment. The identification of some of the more important species is rendered more easy by a series of original illustrations. An appendix gives the records of bird migrations for the past fifteen years, with brief notes upon their habits. This latter should arouse more interest in bird life. It is a most serviceable publication.

Fourth Annual Report of the Superintendent for Suppressing the Gipsy and Brown-Tail Moth, by L. H. WORTHLEY, p. 1–75, 1909.

The magnitude of this work is well shown by the expenditure on the part of the state and some ninety-four infested cities and towns, comprising an

area of more than 5,0000 square miles, of over $500,000. In addition to this the federal government kept the trees and shrubs along some 230 miles of road free from these pests. Though this work is all conducted under the supervision of state authorities, the parties responsible are able to report that the insects have been kept under control, except in woodland districts, where lack of funds made extensive operations impossible. The clearing of trees along the streets and highways has been continued and a special effort made to coöperate with residents along the north shore, additional funds for this latter work being contributed largely by interested citizens and municipalities. The map of the infested area shows that in spite of this enormous expenditure the gipsy moth has been able to extend its range somewhat, while the brown-tail moth has established itself throughout the eastern half of the state. The extensive spraying operations have resulted in the development of an improved and more powerful outfit, especially adapted to woodland work. Experiments continued from the previous year have shown that solid plantings of white pine are not injured by gipsy moth provided they are protected from invasion by caterpillars from adjacent trees. The work on fungous diseases and parasitic insects has been continued. Dr. J. P. Clinton of Connecticut made special studies of the fungous disease affecting brown-tail moth caterpillars, and though his work did not result in establishing a wide-spread infection, this disease was found to be an important factor in controlling this pest. The work with parasites has been greatly increased, some especially valuable forms having been imported from Japan through the agency of Professor Kincaid. Importations of parasites have been larger than before, and some 200,000 of the most active enemies of the gipsy and brown-tail moths were liberated. The extended work with parasites resulted in a number of important discoveries. Doctor Howard and his associates are to be congratulated upon the progress already made in this most promising line of work. We would call attention, in conclusion, to Professor Silvestri's report upon his findings in the infested territory. This Italian specialist highly commends the careful biological work on parasites now being done in Massachusetts and rightfully calls attention to the importance of similar studies under European conditions, because such investigations would prove of great value in determining the relative importance of the various species.

Orchard Spraying—Orchard Protection Work, by FRANKLIN SHERMAN, JR., N. C. Dep't. of Agric. Bull. 6, Vol. 30, p. 1–48, 1909.

This is a very plain, practical bulletin designed especially for farmers not well versed in horticulture. The author does not hesitate to go into such details as the type of spray apparatus, the purchasing of chemicals and the relative benefits to be secured from spraying. The orchard inspection work in the state is briefly summarized and pertinent suggestions made to purchasers of nursery stock. The bulletin is illustrated by a series of original figures and will appeal most strongly to the practical man.

Insect Stories, by VERNON L. KELLOGG, Henry Holt & Co., p. 1–298, illustrated, 1909.

This interesting little book portrays in a simple though effective manner some of the instructive lessons that may be learned by a study and collection

of some of our common insects in the field. It bears directly on nature study of insects, which has been considerably neglected in the past, and should appeal to many youthful readers in such a manner as to direct their attention and arouse their interest in the fascinating study of entomology in the field.

Twenty-Fourth Report of the State Entomologist, 1908, by E. P. FELT, New York State Museum Bulletin 134, p. 1–206, 22 fig., 17 pl.

This report discusses the most prominent features concerning economic species in New York State during the year 1908. Among the insects treated at length are the poplar sayfly, the grape blossom midge, concerning which biological notes as well as technical descriptions of the adults and larvæ are given, the gladioli aphid (Aphis gladioli) a new species found attacking this host, the green cockroach, a central American form which was found in the state during the year, and the common house fly which is considered at some length, including a bibliography of the publications on the species. A list of the publications of the entomologists office and a statement of the donations received is also included. The appendix contains an article by James G. Needham, relative to a peculiar new May fly, in which a new genera and two new species are described, and a Catalogue of the described species of Scolytidæ of America, North of Mexico, by J. M. Swaine. The text is well illustrated by figures and plates and provided with a complete index. This valuable publication should be in the library of every working entomologist.

Contributions Towards a Monograph of the Scolytid Beetles. I. The Genus Dendroctonus, by A. D. HOPKINS, U. S. Dept. Agric., Bur. Ent. Tech. Series, Bull. 17, Part 1, p. 164, pl. 8, fig. 95 (June 30, 1909).

Practical Information on the Scolytid Beetles of North American Forests. I. Bark Beetles of the Genus Dendroctonus, by A. D. HOPKINS, U. S. Dept. Agric., Bur. Ent. Bull. 83, Part 1, p. 169, pl. 2, fig. 102 (Oct. 11, 1909).

These two bulletins, which supplement each other in an admirable manner—the former containing the more technical, or purely scientific matter relating to the species of the genus *Dendroctonus*, the latter the facts and suggestions of economic interest—together constitute the most important contribution hitherto made to the study of the Scolytidæ in this country. They are, moreover, one of the best examples of the high standards that are being maintained by the Bureau of Entomology in the scientific investigation of our insect pests. In this respect Dr. Hopkins' work may, indeed, be regarded as a model not only for all future investigations of the Scolytidæ, but also of many other groups of insects. Confronted with a genus of beetles of very difficult taxonomic affinities and immense practical importance, he has undertaken his task with a truly German "Gründlichkeit" and breadth of view. Before describing the twenty-four known species of the genus he gives a fine account of the external anatomy of *Dendroctonus valens*, the red turpentine beetle, one of the largest

species of the genus. This account is a contribution to the morphology both of the Scolytidæ in particular and of the Coleoptera in general. Then follow remarks on the geographical distribution, ethological peculiarities (Dr. Hopkins unfortunately prefers the words "physiological" and "bionomic"), the range and limits of specific variation, progressive modifications within the genus and the coniferous host-trees that are infested by the *Dendroctoni*. More than half of the technical bulletin is devoted to a minute and orderly account of the species, their galleries, or excavations, broods, distribution, and seasonable relations, with a full synonymy and bibliography, making one of the most complete monographs ever published of a single small genus of insects. The bulletin containing the matter of economic importance is equally full and explicit. It embodies a great number of excellent suggestions for the forester and abounds in careful observations, the result of a practical experience extending over many years. The author gives a number of striking instances of the control of *Dendroctonus* depradations through attending to the proper time for beginning and ending timber-cutting or for barking operations in our coniferous forests. He shows how success in controlling the beetles must depend on a precise knowledge of their developmental and seasonal peculiarities. Considerable space is devoted to an account of the diseases and natural enemies of the *Dendroctoni*. Then the species are taken up *seriatim* and the seasonal history of each is given in detail, with an exhaustive account of its economic features and a minute résumé of its bibliography and the basis of information concerning its habits. The clear and profuse illustrations leave nothing to be desired. The student of forestry entomology will find it advantageous to bind both bulletins together so that they can be used as a hand-book. The only criticism that may be offered is that the author should have prefaced the technical study, which appears as the first of a series, with a brief account of the Scolytidæ in general. Such an introduction would have been a great aid to the American student and would place the genus so exhaustively treated in its proper perspective with relation to the other genera of the family. This, however, is a rather unimportant omission. All entomologists will congratulate Dr. Hopkins on his fine achievement and desire that he may have the leisure and inclination to give us many similar studies of other Scolytid genera.

W. M. Wheeler.

Third Annual Report of the Committee of Control of the South African Central Locust Bureau, by Charles P. Lounsbury, Cape Town, South Africa, p. 60 (1909).

The report outlines the work that have been done during the past year in controlling the locust plague by the different governments in South Africa and includes the proceedings of the annual meeting at Cape Town, which was attended by the representatives of most of the districts which are suffering severe loss from these insects. The officials concerned are to be congratulated on the united and systematic efforts that are being made to check the ravages of these pests.

Current Notes

Conducted by the Associate Editor

Dr. A. W. Morrill, who was recently appointed entomologist to the Arizona Horticultural Commission and the Arizona Agricultural Experiment Station, has moved his headquarters from Tucson to Phœnix, Arizona, and all communications should be sent to him at the latter address.

Mr. F. D. Couden has resigned his position with the Bureau of Entomology at Washington, D. C., and entered a partnership with Mr. Herbert W. Meyers under the firm name of Meyers & Couden. All communications should be sent to No. 432 Pioneer Building, Seattle, Washington.

Mr. Harry Severin, who recently received a post-graduate degree at the Ohio State University, has been appointed State Entomologist of South Dakota. Address, Brookings, S. D.

Dr. A. E. Brunn died at South Woodstock, Conn., September 30, 1909. He was a graduate of Cornell University and was greatly interested in entomology, having published in 1882 a valuable paper on the Tineidæ infesting apple trees at Ithaca, N. Y.

Mr. C. H. T. Townsend, who has been engaged in investigation work on the Tachinidæ at the Gipsy Moth Parasite Laboratory at Melrose Highlands, Mass., has been granted leave of absence by the Bureau of Entomology in order to carry on entomological investigations for the Peruvian government. He will establish an entomological service in that country and will give special attention to the treatment of insects affecting cotton and fruit trees. Great damage has recently resulted to these crops on account of the abundance of certain scale insects and these will be given immediate attention. Address, Lima, Peru.

Mr. Arthur I. Bourne, a graduate student at the Massachusetts Agricultural College, was employed as assistant in the entomological department of the Connecticut Agricultural Experiment Station at New Haven during the summer. Mr. Bourne has recently been appointed an expert and agent of the Bureau of Entomology, Washington, D. C.

Mr. George H. Hollister, who for three years has been field superintendent in immediate charge of the gipsy moth work at Stonington, Conn., has accepted an appointment as forester in Keney Park, Hartford, Conn. Mr. Hollister took up the work in his new position October 16th, where he will have charge of all spraying and planting work in a seven hundred acre park, which is well endowed.

Mr. E. J. Kraus, who recently resigned from the Bureau of Entomology, accepted an appointment as Assistant in Horticulture at the Oregon Agricultural College, Corvalis, Oregon. An error was made in announcing his change of address in a recent issue.

Dr. H. J. Franklin will have charge of the Cranberry sub-station of the Massachusetts Agricultural Experiment Station at Wareham, Mass., where he will conduct extensive experiments on insects affecting that crop.

Mr. S. A. Rohwer, who was Assistant in Zoölogy and Botany in the University of Colorado, has been appointed an Agent and Expert in the Bureau of Entomology, Washington, D. C.

Mr. Myron H. Swenk, who for several years has been Assistant Entomologist of the Nebraska Agricultural Experiment Station, has been appointed Adjunct Professor of Entomology at the University of Nebraska.

The Division of Insects of the United States National Museum has moved to its new quarters in the new museum building, which is rapidly nearing completion. The rooms assigned are on the top floor of the building and for the first time in many years enough space is available to provide the specialists with comfortable working room and to allow the large and valuable collections to be readily available for consultation and study as well as to permit of their further growth. The building is fireproof and most of the collections have been transferred to trays that are kept in fireproof steel cases. This insures the safety of type material, which will be greatly appreciated by all working entomologists.

The Exhibit of Economic Entomology of the Bureau of Entomology, which has been displayed at the Yukon-Alaska Exposition at Seattle, Washington, this summer, has been packed and shipped in two sections. One section has been sent to the United States Land and Irrigation Congress at Chicago and the other to the National Corn Exposition at Omaha, Nebraska.

Mr. Fred Maskew has resigned from the Bureau of Entomology to become Assistant Superintendent of the California State Insectary at Sacramento, California.

Mr. E. A. Schwarz and Mr. F. C. Bishopp of the Bureau of Entomology are in Mexico collecting and making investigations of the ticks of that country.

Mailed December 22, 1909.

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"Studies in Insecticides," by F. B. Lowe, Detroit, Mich. (15 minutes.)

Results of recent work with insecticides.

"Results of Recent Experiments in the Use of Hydrocyanic Acid Gas for Fumigation Purposes," by R. S. Woglum, Washington, D. C. (15 minutes.)

"Carbon Disulfid Fumigation for the Rice Weevil in Corn," by W. E. Hinds, Auburn, Ala. (12 minutes.)

A brief discussion of the results of investigations along this line upon both small and large scales.

"Notes on the Oyster Shell Scale in Montana," by R. A. Cooley, Bozeman, Mont. (10 minutes.)

"Notes on the 'Cigarette Beetle'," by P. H. Hertzog, Lewisburg, Penn. (10 minutes.)

Extent of injury. Fumigation results. Other devices for fighting it and results.

"Collembola as Injurious Insects," by Walter E. Collinge, Uffington, Berkhamsted, England. (7 minutes.)

Illustrates the part they play as carriers of plant diseases by means of the spores of fungi which become attached to their bodies, quite apart from their own depredations due to feeding.

Adjournment.

Program

Wednesday, December 29, 10 a. m.

Reading of Papers

"The Relation of Temperature to the Growth of Insects," by E. D. Sanderson, Durham, N. H. (15 minutes.)

An account of experiments in rearing various insects at different temperatures and a discussion of their theoretical import.

"A Constant Low Temperature Apparatus for Biological Investigations," by E. C. Cotton, Knoxville, Tenn. (15 minutes.)

Description of a plant recently installed at the Tennessee Agricultural Experiment Station, designed to secure and maintain constant low temperatures for the study of problems connected with the life history of the North American Fever Tick. (Illustrated with lantern slides.)

"The Larch Saw Fly (Nematus erichsonh)," by C. Gordon Hewitt, Ottawa, Canada. (10 minutes.)

TWENTY-SECOND ANNUAL MEETING
ASSOCIATION OF ECONOMIC ENTOMOLOGISTS

Boston, Mass., December 28–29, 1909

The twenty-second annual meeting of the American Association of Economic Entomologists will be held at Boston, Mass., on Tuesday and Wednesday, December 28 and 29, 1909. The sessions will open at 10 a. m. Tuesday at the Harvard Medical School, Brookline, Mass. (ten minutes' ride on the electric cars from hotel headquarters). The afternoon session will begin at 1 p. m. and the meetings on the following day will be at the same hours.

Other Meetings

The American Association for the Advancement of Science and its affiliated sociates will hold meetings throughout the week. The meetings of the sections on zoölogy and botany will be held in the same group of buildings as the meetings of this Association.

The Association of Horticultural Inspectors will hold its meeting on Monday, December 27, at 2 p. m. and 7. 30 p. m.

The Entomological Society of America will meet on Thursday and Friday, December 30 and 31.

Exhibits

An extensive exhibit will be made of New England insects, also a special display of equipment and devices for rearing and distributing beneficial species and for treating noxious ones in the field. An exhibit will be made illustrating different phases of the gypsy and brown-tail moth work, and one will be sent from the Ohio Agricultural Experiment Station of insects which are placed on exhibition at state and county fairs for educational purposes.

The information and new ideas that may be secured by carefully examining the exhibits will fully repay any entomologist for attending the meeting.

Hotel Headquarters

The hotel headquarters of this Association and of the Association of Horticultural Inspectors will be at the Copley Square Hotel, Huntington Avenue and Exeter Street, where a rate of $1.50, and upwards, a day has been secured. Members arriving over the Boston & Albany (New York Central) or New York, New Haven & Hartford Railroads should leave their trains at "Huntington Avenue" or "Back Bay"

stations, respectively. These stations are within one block of our hotel headquarters.

Members are advised to secure reservation of rooms in advance, as there will be a large attendance at the meeting.

Railroad Rates

The following information concerning railroad rates has been furnished through the courtesy of Dr. L. O. Howard, Permanent Secretary of the American Association for the Advancement of Science:

A railroad rate of one fare and three-fifths for the round trip, on the certificate plan, has been granted by the Eastern Canadian, the Central and the New England Passenger Associations (not including the Eastern and the Metropolitan Steamship companies), and by the Trunk Line Association. Decision has not yet been received from the Southeastern Passenger Association.

The Southwestern Passenger Association offers no special rate, but suggests that members from Texas, Louisiana, Arkansas, Oklahoma and Southern Missouri purchase tickets to the eastern gateways of the Southwestern Association, and repurchase from such points at the reduced fares authorized therefrom.

From the States of California, Nevada, Oregon, Washington and west of, and including, Mission Junction, B. C.; also from what are known as Kootenay common points, namely, Nelson, Rossland, Sandon, Kaslo and Grand Forks, B. C., the Transcontinental Passenger Association has on sale daily Nine Months' Tourists Fares, approximating two cents per mile in each direction, or about one fare and one-third for the round trip. The nine months' fares apply to the eastern gateways of the Transcontinental territory, and station agents will cheerfully advise delegates as to the eastern points to which it will be most advantageous for them to purchase nine months' tickets in rebuying through to Boston.

The Western Association has on sale revised one-way fares in effect to Chicago, Peoria and St. Louis, with the understanding that persons can repurchase from these points and take advantage of any reduced fares that may be authorized therefrom. The fares to Chicago, Peoria and St. Louis from a large part of the Western Passenger Association territory are now on the basis of two cents per mile; hence, with the reduced fares from the three cities named, the net rate amounts practically to a rate of fare and three-fifths for the round trip.

The following directions are submitted for your guidance:

1. Tickets at full fare for the *going* journey may be secured within three days prior to and during the first three days of the meeting. The advertised dates of the meeting are December 25, 1909, to January 1, 1910, consequently you can obtain your tickets not earlier than December 22, 1909, and not later than December 27, 1909.

From points located at a great distance, from which it takes more than three days to reach Boston, going tickets may be purchased on a date which will permit members to reach Boston by December 25, 1909.

2. Present yourself at the railroad station for ticket and certificate at least thirty minutes before departure of the train.

3. Certificates are not kept at all stations. If you inquire at your station

you will find out whether certificates and through tickets can be obtained to the place of meeting. If not obtainable at your home station, the agent will inform you at what station they can be obtained. You can in such case purchase a local ticket thence, and there purchase through ticket and secure certificate to place of meeting. Be sure that, when purchasing your going ticket, you request a *certificate. Do not make the mistake of asking for a receipt.*

4. On your arrival at the meeting present your certificate to Mr. F. S. Hazard, Assistant Secretary, American Association for the Advancement of Science. It has been arranged that the special agent of the New England Passenger Association will be in attendance at the office of the Permanent Secretary to validate certificates daily (9 a. m. to 6 p. m.) from Tuesday, December 28, 1909, to Saturday, January 1, 1910, both dates inclusive. *A fee of 25 cents will be charged at the meeting for each certificate validated.* If you arrive at the meeting and leave for home prior to the special agent's arrival, or if you arrive at the meeting later than January 1, after the special agent has left, you cannot have you certificate validated, and consequently you will not get the benefit of the reduction on the home journey. *No refund of fare will be made on account of failure to have certificate validated.*

If the necessary minimum is in attendance, and your certificate is duly validated, you will be entitled, up to and including January 5, 1910, to a continuous passage ticket to your destination via the route over which you made the going journey, at three-fifths of the limited fare.

Program

Report of the Secretary.

Report of the Committee on Nomenclature, by Mr. Herbert Osborn, Chairman, Columbus, O.

Report of the Committee on Testing Proprietary Insecticides, by Mr. E. D. Sanderson, Chairman, Durham, N. H.

Report of the Committee on Affiliation, by Mr. Lawrence Bruner, Chairman, Lincoln, Neb.

Report of the Executive Committee, by President W. E. Britton, New Haven. Conn.

Appointment of committees.

Miscellaneous business.

New business.

Annual address of the President, by Mr. W. E. Britton, New Haven, Conn., "THE OFFICIAL ENTOMOLOGIST AND FARMER."

Reading of Papers

"THE MAKEUP AND VALUE OF EXHIBITS AT STATE AND COUNTY FAIRS," by H. A. Gossard, Wooster, O. (15 minutes.)

Illustrated by the Ohio Exhibit. Discussion of the value of such exhibits to the work of the economic entomologist. Inventory of the exhibit, discussion of its separate features, devices for shipping, etc.

"A First Course in Economic Entomology," by F. B. Lowe, Detroit, Mich. (15 minutes.)

The ground it should cover, where it should lead, etc.

Adjournment.

Program

Tuesday, December 28, 1 p. m.

Discussion of the Presidential Address.

Reading of Papers

"Observations on the House Fly," by E. P. Felt, Albany, N. Y. (15 minutes.)

"Controlling the Black Fly in the White Mountains," by E. D. Sanderson, Durham, N. H. (15 minutes.)

Experiments in the destruction of the larvæ.

"The Present Condition of the Gypsy and Brown-Tail Moth Work in Massachusetts," by F. Wm. Rane, Boston, Mass. (15 minutes.)

"Report of the Season's Work on Arsenical Injury to Fruit Trees," by E. D. Ball, J. E. Greaves and E. G. Titus, Logan, Utah. (10 minutes.)

All of the principal apple-growing sections west of the Rocky Mountains were visited, the orchards examined and the soil tested; notes on the findings and experiments undertaken to test the effect of arsenic on trees, with report of progress.

"A New Arsenical Poison for the Codling Moth," by C. P. Gillette, Fort Collins, Col. (10 minutes.)

The results of a brief test of sulfid of arsenic for controlling the codling moth.

"Some Insecticide Methods Used in Combatting the Gypsy Moth," by A. F. Burgess, Washington, D. C. (15 minutes.)

A report on some of the methods used, with remarks concerning their value for fighting other insect pests.

"Some New Facts in Regard to the Lime-Sulfur Solution," by H. A. Surface, Harrisburg, Penn. (15 minutes.)

The different brands of commercial lime-sulfur solution are of different strengths. These were analyzed chemically and the composition of each is given, showing how much each should be diluted to be equal to the standard formula.

Carbonic acid gas used as a power for spraying precipitates the dissolved sulfur. Chemical analyses were made of different samples under this gas pressure, and the results are shown.

Causes are shown for different colors of the lime-sulfur solution.

"Studies in Insecticides," by F. B. Lowe, Detroit, Mich. (15 minutes.)

Results of recent work with insecticides.

"Results of Recent Experiments in the Use of Hydrocyanic Acid Gas for Fumigation Purposes," by R. S. Woglum, Washington, D. C. (15 minutes.)

"Carbon Disulfid Fumigation for the Rice Weevil in Corn," by W. E. Hinds, Auburn, Ala. (12 minutes.)

A brief discussion of the results of investigations along this line upon both small and large scales.

"Notes on the Oyster Shell Scale in Montana," by R. A. Cooley, Bozeman, Mont. (10 minutes.)

"Notes on the 'Cigarette Beetle'," by P. H. Hertzog, Lewisburg, Penn. (10 minutes.)

Extent of injury. Fumigation results. Other devices for fighting it and results.

"Collembola as Injurious Insects," by Walter E. Collinge, Uffington, Berkhamsted, England. (7 minutes.)

Illustrates the part they play as carriers of plant diseases by means of the spores of fungi which become attached to their bodies, quite apart from their own depredations due to feeding.

Adjournment.

Program

Wednesday, December 29, 10 a. m.

Reading of Papers

"The Relation of Temperature to the Growth of Insects," by E. D. Sanderson, Durham, N. H. (15 minutes.)

An account of experiments in rearing various insects at different temperatures and a discussion of their theoretical import.

"A Constant Low Temperature Apparatus for Biological Investigations," by E. C. Cotton, Knoxville, Tenn. (15 minutes.)

Description of a plant recently installed at the Tennessee Agricultural Experiment Station, designed to secure and maintain constant low temperatures for the study of problems connected with the life history of the North American Fever Tick. (Illustrated with lantern slides.)

"The Larch Saw Fly (Nematus erichsonh)," by C. Gordon Hewitt, Ottawa, Canada. (10 minutes.)

"The Unprecedented Appearance of the Saddled Prominent (Heterocampa guttivitta) in Maine," by E. F. Hitchings, Waterville, Me. (15 minutes.)

(Illustrated with lantern slides.)

"Notes on the Corn Ear Worm," by T. J. Headlee, Manhattan, Kan. (15 minutes.)

Two years' study of life history and habits.
Time of planting as a means of preventing the injury it does.

"Notes on Aphis madiradicis," by George G. Ainslie, Clemson College, S. C. (10 minutes.)

A short review of observations and facts gathered in connection with the work on this insect in South Carolina in 1909.

"Notes upon the Life History of Contarina sorghicola Coq," by Harper Dean, Jr., Washington, D. C. (5 minutes.)

A synopsis of the results obtained from a two-year study of this insect in Louisiana and Texas.

"The Cause of Sugar Beet 'Blight'," by E. D. Ball, Logan, Utah. (10 minutes.)

Serious injury from curly leaf or "blight" was found this season in California, Oregon and Idaho, and the fact that the beet leaf hopper was the cause of the serious loss in California some years ago was definitely established. Notes on distribution, food plants and probable areas of frequent injury are given.

"Hibernation of Pemphigus betae," by R. A. Cooley, Bozeman, Mont. (10 minutes.)

"Some Preliminary Investigations of Epitrix cucumeris," by S. Arthur Johnson, Fort Collins, Col. (10 minutes.)

"The Development of Stictonotus isosomatis and Eupelmus allynii," by E. O. G. Kelly, Washington, D. C. (5 minutes.)

The life history and host of these parasites and their economic importance.

"Insectivorous Insects in the Insectary and the Field," by F. B. Lowe, Detroit, Mich. (15 minutes.)

Observations and brief résumé of some experiments.

"Notes on Calosoma frigidum, a Native Beneficial Insect," by A. F. Burgess, Washington, D. C. (7 minutes.)

Notes on the range of the insect, with remarks on its unusual abundance in sections of New Hampshire, which were defoliated by the Saddled Prominent (*Heterocampa guttivitta*) during the summer of 1909.

Adjournment.

Program

Wednesday, December 29, 1 p. m.

Reading of Papers

"Some Notes on the Geological History of the Parasitic Hymenoptera," by Charles T. Brues, Boston, Mass. (15 minutes.)

Some data which bear on the understanding of the group, the relationships of recent faunae and their usefulness in practical entomology.

"The Ermine Moths," by P. J. Parrott, Geneva, N. Y. (15 minutes.)

A discussion of the discovery of a species on imported seedlings and of the economic importance of the insect.

"Further Observations on the Apple Leaf Hopper (Empoasca mali) and Notes on P. nitela and P. cataphracta," by F. L. Washburn, St. Anthony Park, Minn. (15 minutes.)

"Notes on the Life History of Fidiobia flavipes Ash., an Egg Parasite of the Grape Root Worm (Fidia viticida Walsh)," by A. G. Hammar, Washington, D. C. (10 minutes.)

"Methods Used in Rearing the Grape Root Worm (Fidia viticida Walsh) and the Codling Moth (Carpocapsa pomonella L.)," by A. G. Hammar, Washington, D. C. (10 minutes.)

"Spraying for the Codling Moth," by E. P. Felt, Albany, N. Y. (10 minutes.)

"Work on the Apple Maggot," by W. C. O'Kane, Durham, N. H. (6 minutes.)

A summary of the work undertaken in New Hampshire to determine unknown points in the life history and habits of *Rhagoletis pomonella*, and to test certain proposed means of control.

"Notes on the 10-Lined Potato Beetle in Montana," by R. A. Cooley, Bozeman, Mont. (10 minutes.)

"Insects Notably Injurious in Louisiana During 1908–'09," by Arthur H. Rosenfeld, Baton Rouge, La. (5 minutes.)

"Some Insects of the Year in Canada," by Arthur Gibson, Ottawa, Canada. (10 minutes.)

"Insect Notes from Illinois for 1909," by John J. Davis, Urbana, Ill. (10 minutes.)

Notes on injurious insects occurring in the State during the past year.

"NOTES FROM NEW HAMPSHIRE FOR 1909," by E. D. Sanderson, Durham, N. H. (10 minutes.)

Reports of committees.
Miscellaneous business.
Election of officers.
Fixing time and place of the next meeting.
Adjournment.

EIGHTH ANNUAL MEETING
ASSOCIATION OF HORTICULTURAL INSPECTORS

Boston, December 27th, 1909

First Session, Monday, 2 p. m.

Program

Organization.

Remarks by the President, Prof. F. L. Washburn, St. Anthony Park, Minn.

Report of the Committee on General Principles Governing the Association, Dr. J. B. Smith, Chairman, New Brunswick, N. J.

Report of the Committee on National Law, Prof. T. B. Symons, Chairman, College Park, Md.

"THE BROWN-TAIL MOTH ON IMPORTED NURSERY STOCK," Prof. G. G. Atwood, Albany, N. Y.

"REMARKS ON EUROPEAN CONDITIONS AS AFFECTING IMPORTED NURSERY STOCK," Dr. L. O. Howard, Washington, D. C.

"REVIEW OF THE OKLAHOMA NURSERY INSPECTION LAWS AND THEIR EFFECT," Prof. C. E. Sanborn, Stillwater, Okla.

Evening Session, 7.30 p. m.

"WHAT SHOULD BE THE NATURE OF OUR CERTIFICATES OF NURSERY INSPECTION?" Prof. Franklin Sherman, Jr., Raleigh, N. C.

"RESULTS OF VARIOUS REMEDIES FOR SAN JOSE SCALE, BY PENNSYLVANIA ORCHARDISTS, AS SEEN BY THE INSPECTORS IN THE ORCHARDS," Prof. H. A. Surface, Harrisburg, Pa.

"SOME OBSCURE PEACH DISEASES," Prof. J. B. S. Norton, College Park, Md.

"Increasing the Demand for Orchard Inspection," Mr. N. E. Shaw, Columbus, Ohio.

"Local Inspection, Public Sprayers, and the Osage Orange Hedge," Prof. T. B. Symons, College Park, Md.

Questions for Discussion

1. Mail shipments of nursery stock: Is it desirable to endeavor to discontinue this practice?

2. What means can be taken to require the railroad officials to be more strict in demanding certificates when accepting nursery stock for transportation?

3. In view of the fact that there is a demand from growers of nursery stock for relief from destroying slightly infested trees—

Is it desirable to permit spraying of young trees?

If so (*a*) with what formula?

(*b*) How long should such treated trees stand in nursery before final inspection and sale?

4. Are scale marks to be considered prima facie evidence of infestation?

5. Should not nurserymen be required to fumigate all buds and cions, and by what formula?

6. How can we prevent the scale from entering the nursery?

7. What further can be done to control spread of San José scale in nurseries and commercial orchards?

8. Shall we have a law compelling spraying?

9. What shall be done for the owner after his orchard is inspected?

10. Is it desirable to eradicate scaly fruit trees from city lots, considering the cost and objections?

11. What is the attitude of official inspectors relative to permitting supposedly infested stock to be shipped and planted in areas that are generally infested with the San José scale?

12. Shall there be legislation against selling fruits infested with San José scale and the Codling Moth?

13. What are the arguments in favor of inspection and the control of peach yellows and little peach?

14. Should the sale of premature peaches be prohibited?

15. What is the present status of the Crown Gall on apple? How is such considered in issuing certificates?

16. What is new concerning blister rust of the white pines recently discovered?

17. In view of the present information on pear blight, what ought to be done to control the disease in commercial orchards?

18. Is it desirable to appoint a committee to draw an up-to-date list of insects and plant diseases likely to be disseminated on nursery stock?

19. Is it desirable to have a more regular organization of this Association or to consider affiliation with the Association of Economic Entomologists?

Election of officers.

Miscellaneous business.

Adjournment.

The meeting of the Association can be continued Wednesday evening, December 29, at 7.30 p. m., if desired by the members.

The headquarters and meetings of the Association will be at the Copley Square Hotel, corner Huntington Avenue and Exeter Street, Boston.

Report of the Committee on General Principles Governing the Association of Horticultural Inspectors

(Printed and distributed at the request of the Committee in order that the members of the Association may give the report some consideration previous to the meeting.)

1. The first and principal duty of the horticultural inspector is to his constituents, the farmers and fruit growers of his State.

2. Inspection, quarantine and similar laws are passed for the protection of these interests, and so far as the inspector is charged with the enforcement of the laws he must keep in mind always their purpose, no matter what the effect may be on other interests.

3. The inspector owes the nurserymen whose stock he inspects fair treatment and all the consideration that the law allows him to accord, but nothing else.

4. The inspection laws, although meant primarily to protect the horticultural and agricultural interests, are not intended to injure the nursery interests, and they should never be made to bear any more severely upon growers of stock than is absolutely necessary.

5. Between the honest nurseryman and the inspector there should be coöperation and an attitude of helpful interest on the part of the former.

6. The dishonest nurseryman, or one who wishes to dispose of questionable stock to avoid loss, deserves no consideration whatever.

7. The horticultural inspectors, as such, have no interest in having uniform inspection laws throughout the country; the situation in the different States varies so greatly that each State may well be allowed to judge of its own needs and to formulate its own policy, subject to the general provisions of the Federal constitution and laws.

8. The Association of Horticultural Inspectors is a voluntary one, and its members are bound by none of the actions taken at the meetings except as they approve themselves to their judgment.

9. The relation between the members is that of colleagues or comrades

engaged in efforts to the same end, under different conditions, seeking mutual help and information, by free conference at the meetings.

10. As colleagues, each member owes to every other member frankness, honesty and a belief that every man is doing the best he can under his circumstances, and that his certificates are honestly given, and state facts correctly.

11. Each member recognizes the possibility of error in his own work and in that of others, and recognizes also that the receipt of a parcel of infested stock bearing a certificate is not necessarily evidence of either carelessness or lack of proper system on the part of the inspector whose certificate is attached.

12. Each member, whenever he gets track of a parcel of infested stock bearing the certificate of a fellow member, owes it to that fellow member to notify him immediately of all the facts in the case, that an investigation may be made by the inspector concerned and a continued misuse of his certificate prevented.

13. Whenever any inspector has reason to believe that any nurseryman in his State is willing to run risks of shipping stock not suitable for interstate trade into another State, it is his duty to warn the inspectors of neighboring States into which he has reason to believe stock may be sent that stock from such nursery is open to suspicion.

14. It is the duty of every member of this Association to answer frankly and freely every question asked by a fellow member concerning nurseries or other conditions in his State, and it is the duty of the member so informed to consider this information as confidential and not for publication.

15. In case at any time a certificate be withdrawn or a nurseryman holding a certificate be detected in dishonest or questionable practice, notice of such withdrawal shall be at once sent to every other inspector within the region where such nurseryman is known to trade, and notice of such dishonest or questionable practice shall be given to all inspectors in States likely to be affected by such practices.

16. In this Association the rule that should govern all members is, Do unto the others as you would that the others should do unto you.

Submitted by the Committee:

JOHN B. SMITH, *Chairman.*
H. T. FERNALD.
AVON NELSON.
FRANKLIN SHERMAN, JR.
F. L. WASHBURN.

"NOTES FROM NEW HAMPSHIRE FOR 1909," by E. D. Sanderson, Durham, N. H. (10 minutes.)

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From "HORTICULTURE," NOV. 6, 1909.

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(See page 366, Report N. J. Agricultural Experiment Station for 1908.)

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Professor of Entomology in Rutgers College; Entomologist to the New Jersey Agricultural Experiment Stations; New Jersey State Entomologist, etc.

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Prof. Geo. H. Carpenter, B. Sc., M. R. I. A.
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